DEVELOPMENT WITH PRESERVATION

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Environmental Awakening

Readings in Environment

Edited by
BISWAJIT MUKHERJEE
RAHUL RAY

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ENVIRONMENTAL AWAKENING

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Foreword

Ours is a time when the human community is in search of new and sustaining relationships to the earth amidst an environmental crisis that threatens the very existence of all life forms on the planet. From resource depletion and species extinction to pollution overload and toxic surplus, policymakers all over the world are debating the causes and solutions of this crisis; the facts of widespread destruction are causing alarm in many quarters.

As evident, when any environmental problem is in motion, it is difficult to reverse. We are still groping with environmental issues such as pollution of freshwater resources, atmospheric pollution, extinction of biodiversity and urbanization. Even as we struggle with the traditional environmental problems, new ones continue to emerge. It is usually impossible to determine which policy contributes to what change in the state of the environment, and furthermore, there are few mechanisms, concepts, methodologies of criteria for making these policy assessments.

The challenges are formidable and well documented. The solutions, however, are more elusive and complex. Clearly, this crisis has global, national and local dimensions, which require more detailed analysis. Problems at the local level must, therefore, be understood and addressed individually.

The book deals with local problems (like solid wastes, concrete embankment of Kolkata's waterbodies), devises solutions to current problems, frames the future roadmap on certain issues as well as speaks on the legal instruments and information tools related to environmental research. The book is a unique document as it has been prepared with the participation of individuals from diverse institutions around West Bengal. The document presents a comprehensive integrated understanding of the environment of the state. It is a summing up of where we have reached to date as users and custodians of the environmental goods and services provided by our planet. It is also a forward-looking document, providing a vision for us to follow.

While we write this foreword, we gather that linkages between human actions and environmental outcomes are still poorly understood. A more complete and precise analysis will require the development of more comprehensive and long-term mechanisms for monitoring and assessing the effects of environmental policies on environmental quality. It is hoped that this book would be useful to all those seriously engaged in activities related to environmental protection at academic as well as at practical levels.

Biswajit Mukherjee
Rahul Ray

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Stockholm Declaration

(Passed in International conference in Human Environment, Stockholm in 1972)

"The Magna Carta of our Environment"

States the common conviction that:

Principle 1 **:** Man has the fundamental right to freedom, equality and adequate conditions of life in an environment of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations. In this respect, policies promoting or perpetuating apartheid, racial segregation, discrimination stand condemned and must be eliminated.

Principle 2 **:** The natural resources of the earth, including the air, water, land flora and fauna especially representative samples of natural eco-systems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate.

Principle 3 **:** The capacity of the earth to produce vital renewable, resources must be maintained and, wherever practicable restored.

Principle 4 **:** Man has special responsibility to safeguard and wisely manage the heritage of wildlife and its habitat which are now gravely inperilled by a combination of adverse factors. Nature conservation, including wildlife, must therefore receive importance in planning for economic development.

Principle 5 **:** The non-renewable resources must be employed in such a way as to guard against the danger of their future exhaustion and to ensure that benefits from such employment are shared by all mankind.

Principle 6 **:** The discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that series of irreversible damage is not inflicted upon ecosystems. The just struggle of the peoples of all countries against pollution should be supported.

Principle 7 **:** States shall take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.

Principle 8 **:** Economic and social development is essential for ensuring a favourable living and working environment for man and for creating conditions on earth that are necessary for the improvement of the quality of life.

Principle 9 **:** Environmental deficiencies generated by conditions of under development and natural disasters pose grave problems and can best be remedied by accelerated development through the transfer of substantial quantities of financial and technological assistance as a supplement to the domestic effort of the developing countries and such timely assistance as may be required.

Principle 10 **:** For the developing countries, stability of prices and adequate earnings for primary commodities and raw materials are essential to environmental management since economic factors as well ecological process must be taken into account.

Principle 11 **:** The environmental policies of all States should enhance and not adversely affect the present or future development potential of developing countries nor should they hamper the attainment of better living conditions for all, and appropriate steps should be taken by States sand international organizations with a view to reaching agreement on meeting the possible national and international economic consequences resulting from the application of environment measures.

Principle 12 **:** Resources should be made available to preserve and and improve the environment, taking into account the circumstances and particular requirements of developing countries and any costs which may emanate from their incorporating environmental safeguards into their request, additional international technical and financial assistances for this purpose.

Principle 13 **:** In order to achieve a more rational management of resources and thus to improve the environment States should adopt an integrated and coordinated approach to their development planning so as to ensure that development is compatible with the need to protect and improve the human environment for the benefit of their population.

Principle 14 **:** Rational planning constitutes an essential tool for reconciling any conflict between the needs of development and the need to protect and improve the environment.

Principle 15 **:** Planning must be applied to human settlements urbanization with a view to avoiding adverse effects on the environment and obtaining maximum social economic and environment benefits for all. In this respect projects which are designed for colonialist and racist domination must be abandoned.

Principle 16 **:** Demographic policies which are without prejudice to basic human rights and which are deemed appropriate by Governments concerned should be applied in those regions where the rate of pollution growth or excessive population concentrations are likely to have adverse effects on the environment or development or where low population density may prevent improvement of the human environment and impede development.

Principle 17 **:** Appropriate national institutions must be entrusted with the task of planning, managing or controlling the environmental resources of States with the view of enhancing environmental quality.

Principle 18 **:** Science and technology, as part of their contribution to economic and social development, must be applied to the identification, avoidance and control of environmental risks and the solution of environmental problems and for the common good of mankind.

Principle 19 **:** Education in environmental matters, for the younger generation as well as adults, giving due consideration to the under-privileged, is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and improving environment in its full human dimensions. It is also essential that mass media of communication avoid contributing to the deterioration of the environment, but, on the contrary, disseminate information of an educational nature, on the need to protect and improve the environment in order to enable man to develop in every respect.

Principle 20 **:** Scientific research and development in the context of environmental problems, both national and multinational, must be promoted in all countries, especially the developing countries. In this connection, the free flow of up-to-date scientific information and transfer of experience must be supported and assisted to facilitate the solution of environmental problems; environmental technologies should be made available to developing countries on terms which would encourage their wide dissemination without constituting an economic burden on the developing countries.

Principle 21 **:** States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Principle 22 **:** States shall co-operate to develop further the international law regarding liability and compensation for the victims of pollution and other environmental damage caused by activities within the jurisdiction or control of such States to areas beyond their jurisdiction.

Principle 23 **:** Without prejudice to such criteria as may be agreed upon by the international community or to standards which will have to be determined nationally it will be essential in all cases to consider the systems of values prevailing in each country and the extent of the applicability of standards which are valid for the most advanced countries but which may be inappropriate and of unwarranted social cost for the developing countries.

Principle 24 **:** International matters concerning the protection and improvement of the environment should be handled in a co-operative spirit by all countries, big or small, on an equal footing. Co-operation through multilateral or bilateral arrangements or other appropriate means is essential to effectively control, prevent, reduce and eliminate adverse environmental effects resulting from activities conducted in all spheres in such a way that due account is taken of the sovereignty and interests of all States.

Principle 25 **:** States shall ensure that international organisations play a co-ordinated, efficient and dynamic role for the protection and improvement of the environment.

Principle 26 **:** Man and his environment must be spared and effects of nuclear weapons and all other means of mass destruction. States must strive to reach prompt agreement, in the relevant international organs, on the elimination and complete destruction of such weapons.

Sundarbans Protocol

Whereas the relationships between man and nature has become complex and problematic ;

Whereas the nature's endowments are being overdrawn to meet the demands of growing population for fuel, housing, cultivation, raw materials for industries and revenue ;

Whereas the food chain and the natural cycles of water, energy, carbon, nitrogen and minerals etc. are being disrupted ;

Whereas the life support systems inbuilt in nature is getting strained ;

Whereas the extinction of plant and animal species is disturbing the ecological balance ;

Whereas the depletion of ozone layer and gradual global warming due to build-up of carbon dioxide and other greenhouse gases is causing alarm ;

Whereas the ecology stands at the cross-roads of politics, science and economics ;

Whereas income inequalities and illiteracy lead to indifference and hostility to efforts for conservation of natural resources ;

Whereas pollution of air, water and soil is threatening health and productivity ;

Whereas noise, radiation, waste, toxic chemicals etc. are worse confounding ;

Whereas the nature has started taking revenges as manifested by oft repeated droughts and floods, storms and earthquakes ;

Whereas the younger generation in general and future generation in particular, as a consequence of present development initiatives for short-term gains are left to suffer from consequences of desertification, acid rain, climatic changes and biological losses ;

Whereas the ill-effects of pollution are suffered largely by the poor ;

Whereas environment defies any division - natural or man-made ;

Whereas we can go in for a planned development in harmony with nature ;

Whereas we cannot be helpless spectators of history to be written by thermonuclear ink or its geography to be a pen-picture of seething inferno or freezing under an icy desert ;

Whereas based on a common understanding, we can mobilise united and unified social, political and economic activities for conservation of nature, its life supports systems and control population.

We, the people of India, resolve to constitute a "Code of conduct and plan of action" - call it Sunderbans Protocol - and address ourselves to voluntarily work in unity and unison as follows.

- Cultivate a culture for cleanliness.
- Conserve the congenial environment.
- Cordon the treasures of nature.
- Combat pollution and combine the development activity with recycling of resources and appropriate low-cost technology.
- Clean our rivers and green our land.
- Challenge the systems which exploit Nature.
- Constitute an association of citizens of India for creation of a homeland for all living beings.

We do hereby adopt this Sunderbans Protocol for conservation of nature, for rejuvenation of environment and give it to me, to my family, to my neighbour, to my countrymen and women within the frontier and to the brothers and sisters beyond it.

A Resolution proposed by Dr. Ambarish Mukhopadhyay, Minister-in-charge, Departments of Environment and Forest, Government of West Bengal & Chairman, West Bengal Pollution Control Board, seconded by Shri P.C.Tyagi, Chairman, Central Pollution Control Board, unanimously accepted on 1st February, 1989 at Sundrbans, West Bengal in the XXVIII Conference of Chairmen and Member Secretaries of Central and State Pollution Control Boards and adopted in the 76th Meeting of the Central Pollution Control Board at New Delhi on 10th March, 1989.

Awakening of Environmental Ethics

Biswajit Mukherjee

A pollution-free environment is regarded as one of the basic rights of the people throughout the world. The Stockholm Declaration was a declaration guaranteeing a pollution-free environment for the generations to come. The economic degradation of the country may not affect its surroundings, but environmental degradation has no boundary. Environmental refuge is not a new phenomenon in world history; it is also an established historical fact that a number of great civilizations disintegrated due to ecological imbalances caused consciously or unconsciously by the people themselves. The skeletons of many dead civilizations are strewn around the world. They are seen most clearly in harsh, sterile landscapes – the victims of deforestation, overuse, erosion, war and neglect. They are also scattered in the mysterious underground strata of archeology.

The skeletons of the past are found all round the Mediterranean, in the Near East and Middle East, in parts of Pakistan, India and China, in Cambodia, Maxico, Peru. They represent the decline and fall of great civilizations developed by the Egyptians, Romans, Assyrians, Persians, Harappans, Hittites, Khmers, Incas and Mayans, among others.

Some notable scientists and historians are of the opinion that the environmental problem lay at the root of most decaying civilization. There are again others who feel that environmental factors have been ignored and should receive greater consideration, or who link them to a complex pattern or causes. Thus, J. Donald Hughes, Associate Professor of History at the University of Denver, wrote:

> "The decline and fall of the Roman Empire evidently had an environmental dimension ....The Romans placed too great a demand upon the available natural resources ....ecological failures interacted with social, political, and economic forces to assure that the vast entity called the Roman Empire would disappear or be changed beyond recognition".

Climate change is seen by some experts as a force to which civilizations adapt, to others it appears as a major determinant of social welfare. Barbara Bell of Harvard University, has argued that the two dark ages and numerous natural disasters in Egypt and adjacent lands between 2200 B.C. and 900 B.C. "can be given coherence and can all be explained at once by a single primary cause – drought widespread, severe, and prolonged." She added that "a climatic-economic deterioration of sufficient magnitude can set in motion forces beyond the strength of any society to withstand."

Berrard Braudel, the French Historian, has noted that the climate throughout the Mediterranean area in general is disadvantageous in great parts because the substantial rainfall is out of phase with the warmth of summer that explains why the region "affords a precarious living" in spite of its "famous charm and beauty."

The Harappan civilization in the Indus Valley of what is not eastern Pakistan and northwestern India may have suffered severely from drought and floods on its way to oblivion. Reid A. Bryson and David A. Baerreis, of the University of Wisconsin, have concluded that the Rajputana desert in that part of India is largely man-made.

Barbarian invasions are often explained in environmental terms pushing out of their territories in response to drought or other food and water supply failures.

In ancient times the tribal populations responded to environmental threats by migrating from one place to another. The Harappans might have moved to a new environment to create a new society. today, there is no practical way for millions of people to move from the Ganges basin, where they squeeze out a living but face inheritable devastation from floods or droughts.

Most problems involved in the demise of earlier civilizations are still very much with the world today – overpopulation, disease, draught, natural catastrophes, and the degradation of crucial natural resources. And modern societies have added such latter-day environmental hazards as nuclear proliferation, chemical pollution, hazardous waste disposal, and carbon-dioxide-induced climate change. Such problems suggest, in fact, that there is only one indivisible civilization today and that, unlike the past, we have the power to destroy everything. There is now a general awareness that what was happening to the environment – the hazes of pollution hovering in the cities, the filth in the streams, the smelly and unsightly dumps, the threats of radioactive disposal and pesticides may engulf the earth in a total destruction.

Finally, all these desperate perceptions and interests and fears began to fuse together and this fusion produced environmental awakening among the people. Environmentalism is based on a fundamental way of feeling that stresses the importance of the totality of nature and all its diverse parts. There is now a realizing sense of the fact that technological arrogance towards nature is basically an immoral act.

Environmentalists seek to avoid diminishing the resources of the earth and of ruining the environment. Being ecologically conscious, says Skolimowski, means "taking a judicious stock of the existing resources and advocating stringent measures so that they last longer."

Also, we are leaving our descendants a vast legacy of environmental damage that needs to be repaired (polluted plants and rivers, un-reclaimed strip-mined lands), of resources that are over-exploited and depleted (fossil fuels, ground water, forests), of structures that are wearing out (bridges, highways, railroads, dams, urban water systems), and of dangerous wastes that require safe and costly disposal (nuclear wastes, nuclear plants to be decommissioned, toxic chemical wastes).

In a modern industrial society, the control and management of pollution is under pinned by the law. Pollution Laws are both complex and dynamic and the present decade, in particular, has ushered in important changes in laws relating to environment. These changes not only enable the statutory authorities to execute the pollution control laws but also involve popular participation in the implementation of the environmental laws for the protection of their surroundings from environmental pollution. Section 49 of the Water (Prevention and Control of Pollution) Amendment Act, 1988 and Section 43 of the Air (Prevention and Control of Pollution)

Amendment Act, 1987 give power to the people to file complaint cases before the judicial forum. Section 18 of the Environment (Protection) Act, 1986 also gives power to the people to file for prosecution of delinquent industries or any other person responsible for the pollution before the judicial forum. It is also provided in the Water (Prevention and Control of Pollution) Act, 1974 as amended in the year 1988 and the Air (Prevention and Control of Pollution) Act, 1981 as amended in the year 1987 that statutory authorities are statutorily bound to furnish information to the people.

Public Interest Litigation has opened a new dimension in respect of people's movement to protect environment through judicial process. The hours of orders passed by the Hon'ble Supreme Court of India in connection with the Doon Valley case, the Delhi Gas Leak case, were the historic, glorious and splendid moments for the Indian Judiciary. These are significant advances in the direction of the right of the people to protect the environment from degradation.

Orders of the Hon'ble Supreme Court in recent times in connection with a public interest litigation to protect Ganga from pollution, also created sensation. The highest judiciary observed that any riparian industry on Ganga basin should not discharge polluting substances beyond the permissible limit laid down by the statutory authorities.

Hon'ble Supreme Court of India emphasized Sustainable Development for the protection of environment. Hon'ble Court explains that `*precautionary principle*' and `*polluter to pay*' are the guiding principles for Sustainable Development. Relevant portion of the observation of the Hon'ble Supreme Court reads as follows :-

"Some of the salient principles of "Sustainable Development", as culled out from Brundtland Report and other international documents, are inter Generational Equity, Use and Conservation of Natural Resources, Environmental Protection, the Precautionary Principle, Polluter Pays Principle, Obligation to assist and cooperate, Eradication of Poverty and Financial Assistance to the developing countries. We are, however, of the view that "The Precautionary Principle" and "The Polluter Pays" principle are essential features of "Sustainable Development". The "Precautionary Principle" - in the context of the municipal law – means:

(i)Environment measures – by the State Government and the statutory authorities – must anticipate, prevent and attack the causes of environmental degradation.
(ii)Where there are threats of serious and irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
(iii)The "Onus of proof" is on the actor or the developer/industrialist to show that his action is environmentally benign.

"The Polluter Pays" principle has been held to be a sound principle by this Court in Indian Council for Enviro – Legal Action vs. Union of India JT 1996 (2) 196. The Court observed. "We are of the opinion that any principle evolved in this behalf should be simple, practical and suited to the conditions obtaining in this country". The Court ruled that "Once the activity carried on is hazardous or

> inherently dangerous, the person carrying on such activity is liable to make good the loss caused to any other person by his activity irrespective of the fact whether he took reasonable care while carrying on his activity. The rule is premised upon the "very nature of the activity carried on". Consequently the polluting industries are "absolutely liable to compensate for the harm caused by them to villagers in the affected area, to the soil and to the underground water and hence, they are bound to take all necessary measures to remove sludge and other pollutants lying in the affected areas". The "Polluter Pays" principle as interpreted by this Court means that the absolute liability for harm to the environment extends not only to compensate the victims of pollution but also the cost of restoring the environmental degradation. Remediation of the damaged environment is part of the process of "Sustainable Development" and as such polluter is liable to pay the cost to the individual sufferers as well as the cost of reversing the damaged ecology.
>
> The precautionary principle and the polluter pays principle have been accepted as part of the law of the land."

The concept of of Sustainable Development has gained ground as a form of development for which natural resources are not exploited, but are transformed in technologically appropriate and equitable ways. This is the grand vision of a future in which historical conflicts between humankind and nature, and among different sections of people, are reconciled. Yet, even as the rhetoric of Sustainable Development has gained ground it is clear that there are major obstacles in the way. Such as, use of non-renewable energy unscientifically for the purpose of rapid growth of consumerism, militarism and lack of commitment of the political leaders to the environmental issues.

Lack of political commitment is the main obstacle for the sustainable development. Sustainable Development requires changes in socio-political attitudes and structures, and in the specific instruments of development, which at present and not taking place. So both nationally and internationally, behind all the talk about sustainable development and the rhetoric of equity, it seems to be business as usual. Indeed, Sustainable Development itself has turned to be big business.

One astonishing result of the environmental awakening over the last few years has been the development and propagation of a comprehensive environmental philosophy. The movement has succeeded in planting new values in the consciousness of the people so that there is now a general concern about the quality of the environment.

The most important part of the environment philosophy is a humane value system which recognizes the ties that bind – the commonality of interest between humans and the other species that inhabit the earth, as well as the intertwines fate of all humans in the fact of increasingly severe resource crunches. These two interactions – intra-human and inter human and other species – will determine whether environmental values will succeed in preventing a degeneration of our society and leading us towards a self-sufficient future with plenty of room for the full expression of human potential. Such an outcome will depend on the desire and ability of the people to own the new found environmental consciousness and use it in shaping the future.

Roderick Nash, Professor of History and Environmental Studies at the University of California, says that from an ethical rather than an economic perspective, the conservation of species "is justified because, in the last analysis, it is right. The explosive force of this idea is only only beginning to be felt." Nash writes:

"It is intriguing to dwell on the possibility that the quest today for an environmental ethic is an effort to recover something that has been lost rather than to discover something new. Primitive man may well have processed an ethic that extended well beyond his fellow men, one which embraced plants and animals, even mountains and rivers, all seen as members of his community and subject to ethical restraints. It is possible that, under the pressures of individualism, competition, technology, nationalism and capitalism, mankind gradually lost this broad ethical perspective. Today, under the countervailing pressures of internationalism, exhaustion of resources, revision of priorities, and growing understanding of ecological reality, we may be recovering – or rediscovering – something which our ancestors instinctively grasped".

Environmental Issues in 21st. Century

Deb Kumar Bose

Mankind enters the 21st. Century on the heels of triumphs of science and technology achieved in the preceding centuries. The paper deals with the challenge that the century poses for resolution of problems arising from degradation of environment that has been taking place over several centuries. Every century brings to bear on human civilization the distinguishing features of its own 17th. to 19th. Centuries marked the beginning and culmination of industrial revolution transforming agrarian societies into manufacturing ones, The agrarian system had developed relying on human labour and animal power drawing upon the abundance of resources of nature and sun's energy as congealed in the woodfuel. Social structure of the period was characterized by the feudal system where control over serfs and bonded labour was the means for exploitation of the natural resources. Absolute dependence on woodfuel for living and economic activities caused denudation of forests from over-exploitation of resources. Mankind was faced with the first energy crisis in the 18th. Century.

Confronted with similar backlash of nature in earlier times, civilizations of the peoples of Maya. Aztec and Mohenzodaro just disappeared, paying the cost of failure to live in harmony with nature. Conditions were however different in the 18th.

century. Desperate search for alternative source of energy led to ingenuous invention of Newcomen's pump that made it possible to extract coal from deep underground unhampered by continuous seepage of water. The stage was set for locomotives to run on railroad and steamboats on rivers and seas powered by steam engine developed by James Watt and fed by coal. The field was open for introduction of manufacturing machines. It was the age of the great Industrial Revolution. All thanks to the tremendous power of coal that packed within it enormous amount of solar energy collected by trees over millions of years and fossilized by nature's work over further millions of years. There was reason to be satisfied that the new source of energy freed man from the vagaries of nature for availability of the woodfuel. This was not the time to reflect that it was but a Faustian bargain. It was too early to realize that two centuries later, with the impending global warming from gathering clouds of CO_2 and chemical products of industries, mankind would be looking for decarbonization of energy.

20Th Century was the age of science. It witnessed remarkable development of science and technology that conferred on man enormous power to bend nature to its will. Automobile was not only a versatile means of transport that could move goods and passengers over difficult terrain outside the railroad system, it brought about radical changes in the structure of the economy that was caused by change in the lifestyle of people by the novelty of automobiles. Production of automobiles on large scale reduced its cost of production. It was possible to set the price of automobiles at a low level that led to a large demand among the consumers on the one hand, and imparted a push on the industries on the other hand by generating demand for different parts for its production. Automobiles influenced human psyche in a major way. When the cars became available to individuals freely at reasonable rates in the advanced economies, people found it convenient to move over long distances with ease and comfort. It was no longer necessary to stay close to workplace to avoid hassles of tiresome journey to it. By the middle of 20th. Century people moved to locate their residence away from workplace. There was migration of population from established towns to suburbia leading to an increase of movement of vehicles over long distance. To this was added the increase in transportation of goods by manufacturers to dispersed centres of habitation. All this meant an increase in the load of pollutants in the environment in the region.

The means of communication underwent sweeping change when telephone and wireless telegraphy were introduced. Jet planes space shuttles and satellites widened the horizon of human vision to a new order. During the close of the century computers and Information Technology opened up new fields of knowledge for mankind. Notwithstanding the remarkable achievements of science and technology, the century, however, was the one of disillusionment of mankind about its triumph over nature. It was during the century that man's triumph was humbled by the disturbing findings about the gathering cloud of the greenhouse gas, ozone depletion, loss of biodiversity and biophysical limits of human activities.

21st. Century unfolded prospects of achievements in the newer fields of knowledge based technologies. The challenge of the century is to use the arsenal of human knowledge to confront the biggest threat posed to human society by the continuing degradation of environment of the planet earth. It is necessary to understand the characteristics of the environmental degradation in order to appreciate the qualitative nature and the magnitude of the problem. We propose to discuss some of the issues relevant to it.

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The overwhelming nature of the problem of environment came to be appreciated only gradually. Although the Swedish scientist Arrhenius (1896) had warned that we were "evaporating coalmines into the air" causing a change in the transparency of the atmosphere" that could act as a trap to the heat escaping from the earth, little notice was taken of it. It took nearly another century to realize that the phenomena of greenhouse gas and ozone depletion were results of human activities continued from 18th. Century onwards. The realization that the nature has been suffering from irreversible damages led to serious search in the matter. The significant conclusion that emerged from studies in depth by scientists in different disciplines was that the problems of environment were closely related to the activities undertaken at different levels of society and called for concerted actions by the relevant agencies.

Nowhere is the sign of ecological decline more evident than in the rapid destruction of the tropical forests are the reservoir of the most diverse species of flora and fauna of the earth. Every year the forest area is being reduced by about 140,000 acres, an area nearly the size of Nepal. Global forest cover is estimated to have declined by half from the dawn of agriculture. With the increase in demand for food by a growing population the pressure on land was bound to rise for agriculture and animal husbandry. It is natural, therefore, to ascribe to population growth the primary responsibility for inflicting the damages on the environment. Associated with this is the idea that population growth is higher for the countries where poverty is widespread. While the growing population remains a matter of concern, the current trend of population growth shows a decline in the rates of growth not only for the developed economies, but also for the developing economies as well. This appears to contradict the history of demographic transition experienced by the developed economies.

The theory of demographic transition stated that the population for a country increases at a high rate in the early stage of development, as the country attains a high level of development of the rate of growth of the population gradually declines, leading eventually to a stable size of population. The European demographic transition took over 100 years. It was the result of a complex process in which health, education, sanitation and child care, besides the rise in the level of living had significant role. The number of children born to a woman in her life time, known as total fertility rate (TFR), is an important indicator of demographic transition. The TFR for the continent declined from around 4 and 5 to below 2.1 in the 20th. Century. Over the long term, a population that maintains 2.1 TFR will stabilize, the birthrate will equal the death rate. This is known as the replacement rate. (Starke. 2003).

Contrary to the classical theory of demographic transition, some of the Asian countries, as Indonesia, Thailand, South Korea, notwithstanding a relatively lower level of living compared to the advanced economies, have been registering a decline in the TFR approaching the replacement rate. This has been possible largely because of the initiative of the State in these countries to extent literacy, education, health services and family planning practices among the population, particularly among the women. Among the populous countries, China has reached TFR at 1.8. In India TFR declined from 5.2 in 1951 to 3.3 in 1997. It shows that even for a poor country, population growth, culprit for environmental degradation, can be contained if the State follows a comprehensive policy in this regard.

It is acknowledged that poverty affects environment adversely. It is generally held that poverty and environmental degradation forms a vicious circle. But the root of the vicious circle lies elsewhere. The poor peasants and workers are worst victims of degradation of environment and industrial pollution. But degradation of environment cannot be held responsible for perpetuation of poverty. The poverty of the peasants, workers and the unemployed need to be analyzed in the context of the socio-economic conditions and the economic policies pursued by the government of the country. The vicious circle only reflects its impact.

The poorer societies largely depend on agriculture, animal husbandry, and forestry for their sustenance. There are indeed adverse effects of activities of the poor for their living on the environment. The adverse impact of their activities, however, remained mostly confined at the regional level. The same could not be stated about the richer societies. The richer community around the world, particularly in the developed economies, generated demand for goods and services that called for destructive use of the natural resources affecting adversely the environment at global level. Their lifestyle was sustained by the flow of series of sophisticated gadgets and vehicles of different models, continually being replaced by newer models to meet demand that was never satiated. Such goods were manufactured by industries using as their inputs exhaustible mineral resources like oil, coal, iron aluminium, etc. In the process of their production waste matters generated as smoke, dust and chemical effluents were dumped on the environment. Added to these were the non-biodegradable plastic and other packaging materials accumulating on the surface of the earth posing a baffling problem for their disposal.

Mankind was not aware that the pollutants generated by the industries, dispersing out of sight in the sky, did not disappear for good. They moved higher up in the atmosphere and continued to cumulate to form the blanket of the greenhouse gas around the world. It required nearly two centuries to realize that industries have been emitting toxic gases in the atmosphere on the one hand, and chemical effluents on the other, that [pollute the water bodies around the world. The long term effects of industrial civilization, recognized belatedly, have caused a rethinking about the need for developing new technologies for poduction that can minimize the generation of waste matter in course of production. Policy for science and technology has to be reviewed in the context of environmental degradation. The conventional approach of the Pollution Control Boards in India to contain industrial pollution through regulatory measures has not been proving effective. It is necessary to react pro-actively in the matter. An important factor contributing to pollution is the process through which the inputs are transformed into outputs in the industries. It is possible to reduce pollution by developing suitable technologies for the purpose. Scientists and technologists have to provide benign and cost-effective technologies for industries that can minimize the discharge of pollutants in the environment. Search for alternative technologies becomes essential in the interest of protection of the environment.

By the end of the last century it came to be acknowledged that the stocks of fossil fuels, oil and coal, would not last for long. While coal could last for another century or two, depending on its rate of utilization, the reserve of oil would be exhausted much earlier. The matter of greater concern was, however, the threat of the rise in global temperature caused by use of fossil fuels long before they were exhausted. It was urgent, therefore, to look for alternative resource base for industrial inputs, particularly the substitutes of fossil fuels as source of energy. It is imperative to look for means of transition from the present stage of carbon as source of energy to non-carbon sources of energy. Renewable energy sources as hydro-electricity, solar photo-voltaic cells, wind turbines, biomass, etc. hold promise for sustainable supply of environment-friendly power in future.

It is now being acknowledged that for a given configuration of prices of inputs and outputs for power generation, smaller capacity power stations can also co-exist with larger capacity power stations in a large network of T&D system. When the cost of a large T&D system becomes forbiddingly large, alternative energy source may turn out to be economic.

In an exercise undertaken by Chakrabarti and Chakraborty (2002) in India, estimates were obtained, after fixing the cost of supply of energy from a conventional power station upto the 33 KV grind point, for consumers located in the range of 5 km to 33 km of distance from the grid point. The cost of power supply to the consumer at 5 km distant from the 33 KV grid point came to 9.39 paise per kWh and reached 31.15 paise at a distance of 35 km. The cost of energy from a Solar Photo Voltaic module estimated at the respective points, however, remained invariant at 26.10 paise per kWh. Since the renewable energy technologies are based on flow of energy from natural sources they can be installed on any site on the land. The renewable energy technologies are therefore ideal for a decentralized system of power generation.

The renewable energy has also been making dent into comical markets in the developed economies. In California, Sacramento Municipal Utility District (SMUD) had to close down a nuclear power plant that had been incurring continuous losses. (1995). SMUD worked out an integrated power plan liked to the power grid with 3 MW of PV cells. 350 rooftop PV systems and wind turbines of variable speed to back up for the peak load. 200 KV of Fuel Cells were also installed with public support to raise higher tariff for the development programme. 21st. Century is expected to adopt significant measures towards the transition from carbon to non-carbon source of energy.

Intensive use of chemical fertilizer and pesticide in agriculture has been damaging the quality of land, affecting its productivity, and at the same time passing the noxious elements in the runoff into the water bodies. Scientists are concerned about the loss of organic matter in the soil from intensive use of synthetic fertilizer, pesticides and herbicides. It is apprehended that intensive farming cannot be sustainable over long run. High level of inputs as energy and chemicals involve high cost and the latter cause irreversible erosion of soil. Discharge of chemicals as effluents by the industries and their seepage into water bodies cause losss of species including the bacterial elements in aquatic life from pollution of water in rivers, canals, lakes and finally the oceans. Nutrients leached into water from agricultural practice of using large dose of fertilizers stimulate in water bodies copious growth of aquatic plants. When the plants die and decay their bacterial decomposition de-oxygenate the water, leading to death by asphyxiation of many aquatic species. This type of damage is called eutrophication, from Greek eu and trophe, meaning well nourishment. A new initiative taken by people concerned at the declining fertility of land has led to introduction of organic farming with encouraging results. The organic farming based on biomass and livestock wastes can rejuvenate degraded land and effectively substitute for a large proportion of chemicals used in agriculture.

It is not generally realized that nature's resilience to punishment inflicted on it by the humans has a limit. Nature's capability to rectify pollution in water is observed when polluted water is cleaned up in course of its run through a river. It is found that the distance the polluted water is required to run in the river for such cleaning up exercise has been extending over the years. The cleansing property of water resources was due to the presence of bacteria and other microbial elements residing in them. This is one of the services that ecosystem provides to repair the damages suffered by nature. The ecosystem services of the nature purify air of noxiousd gases and rid water of chemical effluents. This capacity of the ecosystem is being severely undermined by human activities.

The ecological system, consisting of biotic and abiotic elements, hosts the economic system managed by human beings. Human activities draw upon natural resources from ecosystem for productive activities and use it as sink for the wastes generated in the process. The whole ecological system comprising of the earth with the atmosphere around it has a finite mass. Since mass cannot be created, growth of any subsystem like economic system can grow only through redistribution of matter within the ecosystem. The ecosystem services function through the biotic elements in nature as biomass in the form of trees, flora and fauna. The growth of biomass is effected by photosynt6hesis that is ultimately determined by solar energy. Human economy, therefore, subsists on appropriation of the products of photosynthesis. To the extent living beings use up biomass as food, the ecosystem loses its share of biomass to repair the damages to the environment. Net product of photosynthesis, measured by the amount of solar energy captured in photosynthesis less the energy used in their own growth and reproduction, consists of the basic food resources of living beings, human beings and animals. Vitousek.et al (1986) estimated that 25% of the net product, covering both land and water bodies including the ocean, is now being appropriated by living beings. In terms of land it comes to 40%. That is, the population at the current level has already utilized 40% of land that can produce any biomass. If population continued to grow at the current rate, it could double in forty year's time, absorbing 80% of the net product possible on land. It can be surmised that the biophysical limit of the ecosystem will be reached even earlier.

This is because the economic system has been growing, but not the ecosystem. That explains why nature's ecosystem has been losing against the demands of a growing population. This can be evident from the case of water resources.

Although apparently renewable through seasonal rains, water is a finite resource. Water supply per person declines as population continues to increase. The first charge on water is for agriculture that has to supply food for the growing population. This is followed by the demand for drinking water, particularly from the needs of growing urbanization. There is a trend for water being shifted from agriculture to cities all over the world. Water bodies have always been the easiest choice for building up urban infrastructure and houses for the citizens. There is little realization that water bodies are essential for recharge of groundwater that serves the needs of the citizens themselves. Besides, water bodies are sinks for airborne pollutants and help moderate the temperature of the region. A comprehensive policy for water should provide guidelines for conservation of water and distribution of water between conflicting demands.

Biological diversity of species, in short biodiversity, is essential for sustenance of life on earth. All the species, flora and fauna on earth are inter-connected in nature in a subtle manner. Not all of this is fully understood by scientists. Man bears a special relationship with trees. Trees provide fruits, timber and useful leaves for man and animals. On the other hand, they are the scavengers of the earth absorbing CO_2 from the greenhouse gas. Trees multiply through seeds generally obtained from the fruits. Seeds are distributed by birds and animals through their excreta. Butterflies pollinate flowers that grow into seed. The whole system is linked in a chain, as it were. A break in the chain may occur in any of its links destroying the system. If, for instance, the habitat of the butterflies is disturbed in some way, the process cannot start. The trees cease to bear fruits and the consequences follow. Trees cannot multiply any longer. The earth is home for millions of species; only, a fraction of which has been discovered so far Scientists hold that the earth is covered by a web of inter-connected species, like a membrane around it. Each of them has distinctive role in supporting the life forms on earth. Biologists are concerned to witness the fast disappearance of the species by the destruction of their habitats from human activities. "If the current rate of habituate destruction we3re to continue in forests and coral reefs alone, half this species of plants and animals would be gone by the end of the 21st. Century. Our descendents would inherit a biologically impoverished and homogenized world, with disastrous species such as fire ants and house mites widely spread. Humanity would then have to wait millions of years for natural evolution to replace what was lost in a single century. Humanities' food supply comes from dangerously narrow silver of biodiversity. Throughout history, people have cultivated or gathered 7000 plants species for food. Today only 20 species provide 90% of the worlds food and three – maize wheat and rice – supply more than half" (Wilson.2000).

Our antibiotics, anticancer agents, pain killers and blood thinner are extracted from a few hundred wild species of plants. The biosphere in the ecosystem renews our soils, provides energy, clean water and fresh air we breath. The stability and resilience of the ecosystem depends on the prevalence of more wild species. Global conservation of nature's resources can be assured by the amount of biodiversity we carry through the generations.

Next to industries, automobiles and vehicles run on petrochemical fuels has been the biggest pollutant. Automobiles introduced a new culture pattern in society.

Facility for expeditious movement over long distance encouraged people to settle in dispersed areas away from congested big cities. It gave rise to the massive traffic of commuters across the countries, moving back and forth from places of residence to workplace. The vehicles emitted noxious fumes of carbonic and nitrous oxides that added to the greenhouse gas.Cars being mostly individually owned tended to grow in number with population growth and remained a source of serious concern for degradation of environment. Provision of mass transport services at reasonable cost could have contained the growth of individually owned cars, as was the experience in the erstwhile Soviet Union. The developed economies, however, having committed themselves in a bind from which there is no easy escape. The developing economies, witness to the damaging consequences of the automobile culture, on the other hand have some of the options open to them which are presently lost to the developed economies. It is possible in these countries to organize mass transport system by the state in a planned manner to win people away from personal car habit. The railways have a number of advantages over other forms of mass transport. In the developing economies the cost of operation of the railways was low in real terms, because of their utilization at close to full capacity compared to those in the developed economies. The railway system had a historical role in fostering economic activities along the railway stations that served as nodes for development of the regional economies in the hinterland. The Highways on the other hand had only a limited impact on the wayside economies, because the system was organized to speed up traffic between origins and destinations in distant locations. The railways used much less of energy and natural resources per ton-kilometer of goods and per passenger-mile. Smoke emitted by the railways had lesser impact on environment than industries and automobiles. Still less was the impact of the railways run on electricity. Transport policy of a country had, therefore, to be determined in conformity with the environment policy.

Modern megacities with concentration of large population require their food and consumer goods to be transported over long distance. Even water for large cities have to be conveyed from distant locations shifting them from traditional use in agriculture. The advantages of economy of scale in the large cities encouraging concentration of trade and commerce catering to a large market are matched by the 'cost of haulage of goods over long distance. What are not accounted in here are the cost of environmental pollution from automobiles and industries and the cost of disruption in social life from tension arising from concentration of a large population in a rather small area.

An alternative to this could be a decentralized pattern of urbanization. Smaller towns located in a dispersed areas supported by small and medium industries can meet many of the citizen's demands from local products. It will be possible to dispense with import of such goods from distant locations saving on energy and providing for local employment. Towns and cities are built by covering up the greens with cement and tar that prevent seepage of rain water underground that could recharge groundwater for the residents. Water bodies around the urban sites are filled up for construction of buildings. There is standing conflict of interest betwe4en the developers and the owners of wetland around the urban centres. The net result may be dearth of water for the residents themselves. The decentralized urban centres can have water bodies and agricultural fields in the neighbourhood to serve the needs of the citizens. The urban sites need to provide for adequate green areas and water bodies within and around the sites for their cooling effects on the climate. An Environment Policy should be devised at the national level to guide the policy for urbanization keeping in view the need for protection of environment.

Degradation of environment is a global problem. It originates primarily from human activities taking place all around the world. Its impact also is all pervading, extending over all the countries. This is for the first time that mankind faces a common threat that cannot be dealt with separately by any country for itself. It requires concerted action by all nations. All human activities relating to agriculture, industry and services are required to be re-designed in the interest of the overriding consideration for protection of environment so that future generations are not deprived of the benefits enjoyed by the current generation. This calls for re-appraisal of technologies based on fossil fuels in industry and transport, overmuch dependence of agriculture on chemical inputs, excessive withdrawal of ground water for agricultural and drinking water needs, particularly in urban centres, and wanton destruction of forests for commercial purpose. There has to be a change in the mindset of the population accustomed to a lifestyle patterned on the use of goods and services produced from exhaustible resources of nature and prepare for changeover to one based on the renewable resources of nature. The third world has one advantage in this respect. They are armed with the experience of the developed countries, which did not have much knowledge about the consequences that followe4d the great rush for industrial development based on emerging technologies over about two centuries. They had little choice for themselves. The third world, being in the early stage of industrialization has the option open to them for choosing an environment-friendly path of development. It is difficult, however, to achieve such objectives under the system where large monopoly producers, whose vested interest is to persuade the consumers to use their products as long as it served to maximize their profits, control the market.

Repeatedly one comes to face the conflict between the framework set by the capitalist system and the demands of environmental protection in our time. Short of any radical change in the social system, one has to depend on the State to intervene to regulate and guide the market to serve the general interest.

References

1. Arrhenius, S. 1896. "On the influence of carbonic acid in the air upon the temperature of the ground" in The London Edinburgh and Dublin Philosophical Magazine and Journal of Science, April, 237-276. Cited in Weiner, Jonathan, (1990), The Next One Hundred Years Bantam Books London New York.

2. Chakrabarti, Snigdha and Subhendu Chakraborty, 2002, "Rural electrification programme with alternative energy in remote region "Energy Policy, vol.30. Issue 1, January, 33-42.

3. Sacramento Municipality Utility District, 1995, Integrated Resource Plan Activity. Municipal Power Goals in Competitive Age SMUD, California, USA.

4. Starke, Linde (Ed), State of the World 2003. Earthscan Publishers Ltd, London.

5. Vitousek, P.M., P.R. Ehrlich., and P.A. Matson, 1986. "Human appropriation of the products of photosynthesis", Bio Science, 34, no 6: 368-73.

6. Wilson, Edward O, 2000, "Vanishing before our eyes." TIME, April 26, 28-31, Los Angeles Times Syndicate.

Towards An Alternative Paradigm of Development

Samar Bagchi

Why search for an alternative ?

The world is facing today an ecological crisis. The human survival is endangered. Recognizing this crisis, every other day one conference or the other is taking place in the world to meet the challenges. We had the conferences at Stockholm, Rio de Janeiro, Johannesburg in 1972, 1992 and 2002 respectively. In 2001 United Nation has launched a Millennium Ecosystems Assessment Programme in which 1500 scientists from all over the world will assess the situation of earth's oceans, land, air, biodiversity and all other aspects of environment. In 2003 an Earth Observation Summit was held for the first time in which Ministers and delegates from more than 30 countries participated. The summit adopted a declaration calling for the development of a comprehensive coordinated Earth observing system. International panel on climate change (IPCC) is meeting regularly to plan and consider actions against global warming and climate change. In fact, all the five important aspects of nature - Forest, land, water, biodiversity and air are under severe stress. The social situation, both in the third and the first world, is also crumbling.

In the name of making this world a global village the advanced industrialized countries are trying to control the world economy. Cultural hegemony is being imposed on the world through the electronic media. The society and economy of many countries in Africa, Asia and Latin America have been devastated. This article will try to analyse the world economy, society and environment and will try to attempt for an alternative paradigm of development.

World economy and society

Before colonization and completion of Industrial Revolution (1760-1830 AD) the economic condition of the so-called third world was better than the first world. In 1750, before the Battle of Plassey, per capita income of today's third world was $ 190 per year when today's first world had an income of $ 180. In 1750, Asia's share of world's production was 80%. In 1800, per capita GNP of China was $228. In England and France it ranged between $ 150 and $ 200. By 1950, China's GNP had declined to $ 170 per capita per year. The Table 1 below shows the world, economic situation today :

Table 1 Distribution of world income

Country	% of world population	% of world's income
India	16.10	1.14
43 least developed countries	58.00	4.00
24 High income countries	15.45	82.11

(*World development report of World Bank, 1992*)

Table 2: Per capita per year GDP in dollar.

The average Gross Domestic Product (GDP) percapita per year is given in below :

Country	1970	1990	2000
U.S.A.	4922	21790	34260
Germany	3049	22320	25050
Japan	1930	25430	34210
China	120	370	840
India	100	350	460

In all countries of the world the difference in income between the rich and poor has increased. In 1960 the ratio of income between the richest 20% of the world and the poorest 20% of the world was 30:1. In 1991 this ratio shot upto 61:1. In 1999 it become 74:1. The ratio of income between the richest and the poorest countries was :1920 - 3:1; 1950 - 35:1; 1975 - 45:1 ; 1992 - 75:1; 2000-2001 - 100:1. Only 225 billionaires own 47% of world's wealth. The wealth of only 3 billionaires is equal to the national income of 48 underdeveloped countries. In the under developed countries 1.2 billion people has an income of $ 1 per day and 3 billion people has income of $ 2 per day. The average rise of GDP in the 3rd. world countries between 1961 and 1970 was 3.3%. Between 1986 and 1990 it became 0.1%. In the late 1990s only 33% on the world's labour force was either fully or partially unemployed.

Before colonization was established in the 18th. century the people of the third world used to live roughly in a self-reliant and self-sufficient social situation. Depending upon the geo-climatic condition they used to grow wheat, rice, millets etc. catch fish, hunt and used natural resources more or less sustainably. They used local materials for their homes, clothes and other necessities and by using local craft technology maintained their livelihood. Whatever excess production was there they sent it to the national and international market. But, basically the production was made for local use. The production system and the lifestyle of the majority of the people was more or less in harmony with nature.

With the establishment of colonialism the situation changed completely. The colonial countries gradually became the supplier of raw materials and the market for industrial goods from the western world. A new kind of economy and new kinds of crops were imposed on the people. The forests which were common property were made "Reserve Forests" through Forest Acts of 1865 and 1878 by the British rulers for commercial exploitation. The forest ecosystem was disrupted which jeopardised the hydrological and nutrient cycles of nature. The traditional free access of forest communities was curtailed. In the 1930s there was forest 'satyagrahas' by the forest communities against the conversion of common resource like forest for exclusive exploitation by British rulers for commercial purposes.

The socio-economic condition of the colonized world dramatically changed. Whereas in 1878 countries like India produced 674 grams per capital food grains it became 337 gms. when the Britishers left in 1947. Famines became our constant companion. The craft industry of India like textiles, steel, zinc etc. got completely destroyed due to the imports of foreign goods. Countries like India became the captive markets for the rising capitalism of West. The craftsman lost their jobs and the pressure on land increased. The onslaught of new economy, culture, the demand of western consumer items got entrenched in the minds of upper classes in such a way that after the independence all such colonial countries adopted western values, consumerist lifestyle and technology. The third world became more and more dependant on international trade, economic system and investment.

Gradually, it became the play ground of giant multi-nationals. They started taking aids from World Bank, Asian Development Bank (ADB), International Monetary Fund (IMF) etc. for infrastructural development like road, dam, communication, heavy industry etc. Foreign research institutions, scientists and foundations undertook researches for new agriculture and technology. They applied those in the third world to make them "modern" and dependant and to integrate these newly independent countries with the western technology and economy to keep subjugation intact. The economy of many such countries collapsed. In the beginning of 1980s Ghana was one of the richest countries in Africa. Under the pressure of so-called `development' prescribed by the international funding agencies Ghana is today one of the poorest countries. In 1950, India had foreign debt of only 89 paise per capita. To-day, it is about Rs.5,000/-. A large chunk of India's budget goes for debt servicing and more aid is taken from the industrialized countries. India is getting into a debt trap in which Brazil, Mexico and other countries went through. From the decades of 1970s. the golden age of capitalism of post second world war period ended and it entered into a long standing economic crisis. From the 1980s. due to the pressures from neo-liberal economic pressure from the U.S.A. the IMF and World Bank imposed Structural Adjustment Programme on the third world countries. The economy of many countries collapsed. The international capital is today suffering from over production and over accumulation of capital.

Capitalism and globalisation

Capitalism is a world system. The crisis of capitalism has been witnessed a number of times in the past. The first expression was during the first world war. The second time during the 1930s international slump and the third during the second world war. This crisis again developed dramatically in East Asia in 1997 July. In the same month two influential journals of USA announced the end of the cycle of capitalist crisis. The Information Revolution will bring out this economic progress. The `Foreign Affairs', an influential foreign policy journal of USA in an article 'The end of business cycle' wrote 'globalisation of production and consumption have reduced the volatility of economic activity in the industrialized world'. Expressing the limitless possibility of information technology the journal `Wired' in an article 'The long boom : a history of the future' wrote 'transition to a networked economy and global society'. But such is the irony of history that the date in which the above declarations were made, in the same July 2 Thailand devalued its currency. The crisis of 'Tiger' economics of East Asia spread from one country to the other and the whole capitalist world had a shock. South Korea, Thailand, Indonesia, Malaysia and Taiwan economies got a severe shock which proved the hollowness of the claims of the proponents of globalization. Half of the investments that were made in the developing countries were made in East Asia. The `Tiger' economies of East Asia were shown as the success stories of globalization. But the crisis in the economies of East Asia in 1997-98 was a great danger to world capitalism. The journal `Business' wrote that the crisis is 'the biggest threat to global prosperity.' Of course, the `prosperity' is not of the whole world but of the rich world. The crisis that came in the `tiger' economies was not due to corruption in the countries or due to excessive controls in the economies. The main reason for this was the over accumulation of capital which reduced the profit. Due to the large investments in East Asia the production capacity had increased greatly. It could not be used to earn increasing profit. More the market became competitive more and more factories, mines, big cultivation farms and infrastructure were being set up. When overproduction takes place it might seem unreasonable to set up new productive capacities. But to sustain in the competitive market there was no other alternative to a capitalist enterprise. The firms whose production cost is lower, have new technology, labour discipline, low labour wage and market can survive. Due to this the investment and production increased constantly. There was an unprecedented expansion of production of automobiles, steel, electronics, computer chips, fibre optics etc. in East Asia. Due to this there was a crisis of over production and profit went down. The production of automobiles in 1998 was 21 to 22 million in excess of demand. That was 36% more than the demand of the world market. Inspite of this, to remain in competition the automobile manufacturers went on establishing new capacities in East Asia. Before the 1997-98 crisis, leaving aside Japan and S. Korea, the other East Asian countries, where there was already over production, planned to double their automobile production. The same thing happened in the cases of computer chips, semi conductor, optical fibre, chemicals, steel etc. The supply of Dynamic Random Access Memory Chips (DRAMS) was already 18% more than the demand. In 1995 there was no crisis of over production of DRAMS. Due to overproduction the price of DRAMS in South Korea which controls 40% of DRAMS' market, started falling drastically. In the beginning of 1997 the price of 64 megabyte DRAMS was $ 60. In the end of 1997 the price fell to $ 20 and in 1998 it went down to only $ 4. The reason for the East Asian crisis is the over accumulation of capital.

Even after the crash of Thailand's currency in 1997 IMF and quite a few foreign banks announced the stability of Indonesian economy with confidence. They didn't predict any slump in the Indonesian economy like Thailand. Within months of such bold announcement the flight of capital from Indonesia started. The foreign debt of Indonesia stood at $ 40 billion. The flight of international capital took such a turn that a crash came in the Indonesian economy. The ratio of debt to the foreign banks and GDP increased from 35% to 140%. In different countries of East Asia similar crisis appeared and the `Asian Tigers' were converted to "Asian Mice".

After the fall of USSR the cold war ended. But the industrialized capitalist world did not reduce their military preparedness. The defence budget remained the same or increased. Millions of people were engaged in military affairs. So to maintain the arms sale the military system was essential for those countries. So it was necessary to have small or big local wars and terror situations. So we hear from America the menacing cry of "clash of civilization" and "Axis of evil".

Modern industrial society

The modern industrial society goes on increasing the production of goods for gluttomous consumerism. In 1800, at the middle of Industrial Revolution, when an American used to go to the market he could buy only 300 items in a market space of 150 sq. mt. Today, when an American, living in a city having 100000 population, goes to the market he can buy 1 million items in a market space of 1.5 million sq. mt. This giant industrial system is being imposed in the third world. But the majority of the world are poor. They do not use all these industrial products. In India 80% of the people do not consume such products as they do not have the purchasing power, being poor. In the past whatever products the craft industry produced was used locally to lead a simple lifestyle. The technology was simple and labour intensive. Today's glittering advertisement of innumerable consumer products have replaced the earlier simple products. People have started feeling that the use of those old products have no dignity. The media advertisement creates an artificial scarcity conditioning of human mind and abundance of consumer products is considered as standards for social prestige. This is called progress and development.

The third world, aping the West, started establishing infrastructure and industries. The market demands of modern consumer items increased the share prices. Modern capital intensive industries, which are mostly foreign, started being established in the third world. This crushed the indigenous traditional industries.

These countries, aping the West, started building big dams, steel, cement and chemical industries, wide highways, bridges, fly-overs, car manufacturing factories, giant metropolis, tall buildings, air ports etc. The elite leadership of the third world thought that they can develop their country and improve the quality of life of the people in the western model. To implement the western development model millions of people have lost their hearth and home and have become homeless refugees. In India most of them are dalits and tribals.

To implement such big projects the third world countries started taking loans from World Bank, IMF, other international funding agencies and western countries and gradually got into a debt trap. In today's age of globalization the industrialized countries are sucking the forests and minerals using the cheap labour power and land of the third world countries to maintain their industrial system and keep production going. We have to remember that only about 25% of global population live in the first world. But they enjoy more than 80% of global wealth. But, by using the natural resources the industrialized world produces consumer items most of which are not the essential needs of humans. The table below (Table 3) gives the expenditures on some of those luxury consumer items used by some of the developed countries.

Table 3

Countries	Luxury items	Expenditure in billions of dollars.
Europe	Alcoholic drinks.	105
Europe	Cigerette	50
World	Narcotic drugs	400
World	Military expenditure	780
Europe & USA	Pet food	17
Japan	Business entertainment.	35
Europe	Icecream	4
USA	Cosmetics	8
Europe & USA	Perfumes	12
	Total $	1411 billion

(UNDP World Development Report 1998).

If we take into account the expenditure made by the rich people of the whole world on all such luxury items then the figure will be astronomical. To produce such inessential items forests, land, water, air, bio-diversity are being plundered. New kinds of diseases are appearing. Millions die of diseases, nature is getting devastated. The life and livelihood of future generation is being jeopardized.

The money that is spent by the rich of the world could have solved many of the problems faced by the marginal people of the world. The expenditure to solve some of the problems faced by the poor of the world is given in Table-4.

Table – 4

Primary education for all in the world	$ 6 billion
Drinking water and sanitation for all	$ 9 "
Mother care for all	$ 12 "
Primary health and nutrition for all	$ 13 "
Total	$ 40 billion

The newly liberated countries of the third world after the second world war undertook the same developmental paradigm of the West. The leaders and the scientists of the third world believed that they would improve the living condition of the people through science, technology and industrialization. The type of economy and production that were introduced in the countries like India has no relation with the majority of the people. Rather, the life and livelihood of those people and of the future generation were jeopardized. The industrial societies based on capital are suffering from a deep crisis of over production and over accumulation of capital. Capital is not finding place for investment. Capitalism has taken the shape of `Casino capitalism' where the daily transaction of foreign currency is $ 1800 billion. Whereas, the daily import-export trade is only 18% of that transaction. The advanced countries are imposing globalization tactics to come out of the crisis. The globalization is hastening the disaster in the third world countries. The division between the rich and poor all over the world is increasing. The market of the rich countries in 1960 was 37 times more than the poor countries. Today it is 74 times more. The situation is such that the wealth of only three multi billionaires is equal to that of 48 least developed countries. In 2001 there were 826 million people who were hungry, 484 million people were illiterate and 325 million children did not go to school. 200 million people had no access to cheap medicine and 2.4 billion people had no arrangement of sanitation. The life expectancy of sub-saharan people is less than 30 years compared to the developed countries. It is more like the globalization of genocide.

Through he GATT, Intellectual Property Right and World Trade Organization the plan to capture the market of third world has started. Different countries of the third world due to wrong social planning gradually submitted themselves before World Bank and IMF . India agreed to a structural adjustment programme of their economy which started in 1991. The Government started withdrawing from its responsibilities like health and education which are rapidly being privatized. In the new Water Policy announced in 2002 there is clear signs of privatizing water. In the name of liberalization and free trade privatization of state industries and institutions have started. As per WTO terms doors have been opened for imports of foreign goods. Inspite of the fact that India has surplus food stock foreign food grains are imported. Food grain prices are falling. The ratio of the prices of agricultural and industrial products is fast falling in the international market. The prices of all types of agricultural products have fallen by 50%. Signs of economic collapse of 1930s are appearing. To earn foreign exchange land-use pattern of the country are being changed. Along with all these in the name of application of science and technology there is the onslaught of green revolution and bio-technology. The food security of India is in danger.

The farmers of India are being indebted, ruined and committing suicide. In Andhra Pradesh alone more than 3000 people have committed suicide in 2003 and early 2004. USA and other international financial institutions are pressurizing India to withdraw the subsidies in agriculture and power. But Europe and USA is subsidizing their agriculture in a very big way. In 2001 the OECD countries have given subsidy in agriculture to the tune of $ 27 billion. In the western countries the daily subsidy in agriculture is $ 1 billion.

Today, the world capital has started globalizing culture along with economic globalization with the help of electronic media. Hegemonising of mind is being made. Mind is being conquered. What we should eat, wear or think are being monoculturized. In the world of nature monoculture brings disaster. In the various parts of the world protests are being made against neo-liberalization and making the market a new religion. Storms of protests have been held from Seatle to Washington by thousands of marchers against World Bank, IMF, WTO and the rule of capital. The neo-liberal economy has also made the life of common man in West unbearable. To-day the earning of top 1% is more than the bottom 40%. During the last 20 years the number of children living in poverty has increased three times. In the triennial world congress of International Council of Museums in 1989, in which the present writer was present, the keynote speaker Neil Postman, an American thinker, said "We have organized our society to accommodate every possible technological innovation. We have deliriously, mindlessly, willingly ignored all consequences of our actions. And have, because technology requires it, turned our back on religion, family, children, history and education. As a result of which American civilization is collapsing. Every one knows this to be true but seems powerless in the face of it". Thus we find that both third and first world are at the brink of a disaster. Though the collapses of two worlds are different in nature.

The burgeoning production that the world has witnessed after the Industrial Revolution has caused the wanton destruction of all the five resources of nature on which life depends. The five resources are forest, land, water, bio-diversity and air.

Forest

Each year about 17 million hectares (ha) of forest vanish from earth of which about 15 million ha is the tropical forest. To produce only the Sunday edition of the New York Times 25 ha of forest has to be cut. It has been estimated that all tropical forests of earth would vanish by 2030. If in Asia 5 parts of tropical forest is cut only 1 part is planted. This ratio is 29:1 in Africa and 10:1 for the whole world. But the trees which are planted are normally monoculture trees. It's not regeneration of tropical forest which harbours tremendous bio-diversity of plants and animals. India had three times more forest 100 years back. During the 20th. century 89% of India's prime forest cover has vanished leaving only 11% in the 1990s. Every minute about 30 ha of India's evergreen forest is lost. Brazil has lost 95% of its coastal rain forest to convert it into grazing land and plantation. The forest and the land-use pattern of many third world countries are being changed to supply meat, flower, fruits, coffee, sugar or other cash crops for profit jeopardizing the food security.

Land

The destruction of forest, change of land-use pattern, destruction of grasslands etc. is causing desertification in various parts of the world. During the last 50 years or so, Sahara desert has engulfed 6.5 million sq.km. of new area. In Morocco, Libya, Tunisia and Algeria 100000 ha. of land has been converted to desert after 1930. India's Thar desert is advancing at a rate of .8 KM. every year engulfing about 13000 acres of land. When the settlers came in America 500 years back it had 3.2 million Sq. KM. of forests. Today, it has only 0.22 million Sq. KM. To supply timber to Germany alone the third world is losing 200000 ha of tropical forest each year.

Desertification engulfs .6 million ha of land per year. Each year the third world loses 56 million ha to waste land. Each year the world loses 24 billion tons of top soil of which India's share is 6 billion tons. Nature takes thousands of years to make 1 inch of top soil. If forests vanish then in 28 months that top soil is eroded away. Due to soil erosion 20 million ha. of cultivable land is lost each year. 3.5 billion ha. of land is being affected by desertification, one-third of which is in severe strain.

Water

The oceans, rivers and wetlands are having serious threats due to pollution. Moreover the wetlands are shrinking all over the world due to urbanization, industrialization, conversion into agricultural land etc. USA has already lost it's 50% of wetlands and is losing 3 to 5 million acres of wetlands every year due to urbanization etc. We are witnessing similar kind of loss of wetlands in Kolkata and all over India. East Kolkata wetlands and ponds are vanishing fast due to rapid urbanization. Wetands have a very important ecological functions to play like being the spill basins for surface flows, repositories of bio-diversity etc.

In 1992, it was estimated that 2.3 billion gallons of municipal wastes and 4.9 billion gallons of industrial wastes were released in ocean coasts. In all countries of the world rivers are carriers of wastes from sewer and industry.

The industrial world produced, as per 2000 AD estimates, 2 million gallons of hazardous nuclear wastes, a part of which is in India. Highly radioactive liquid nuclear wastes are created in the plutonium reprocessing plants at capellafield in England and La Haage plant in France. Millions of litres of such radioactive wastes dumped in the Irish sea due to which such deadly wastes are carried by water to different European countries. An Independent French Laboratory ACRO of France has analyzed and found that highly radioactive nuclear substances like Cobalt 60, Ruthenium 106 and Americians 241 have got deposited in the sea bed. The concentration of Cobalt 60 is 560 times more than the permissible limit set by European Regulation. In the teeth of the children of England, Scotland, Wales and North Ireland Plutonium 239 has been found.

If we look at the situation in West Bengal millions are suffering from arsenic poisoning because of arsenic contaminated drinking water. This is because of huge withdrawal of ground water for irrigation of rice crops during winter season. This huge withdrawal of ground water has lowered the ground water level causing drying up of ponds and dugwells in various parts of India. It has caused disaster in the life and livelihood of the marginal farmers of dry regions of India who used to cultivate dry land crops by harvesting rain water in ponds and dugwells and other similar structures.

Biodiversity

When forest and wetlands vanish, water of wetlands, soil, rivers and oceans get polluted the bio-diversity also vanish. Tropical forests harbour about 50% of the species of the world. It has been discussed how the tropical forests are vanishing. Pollution of land and water due to cultivation of Hyv seeds which require lot of fertilizer and pesticides cause erosion of species. Due to all these causes 100000 species are threatened with extinction every year. Before the advent of man on earth there was extinction of 1 mammal in 400 years and 1 bird in 200 years. This is known as Background Rate of Extinction. Today the extinction rate is many many times more In 1980 one species per day and in 1990 one species per hour. During the last 300 years 115 birds and 58 mammal species have become extinct. This is 50 times more than the

Background Extinction Rate that prevailed in geological times.

India had, before the introduction of `Green Revolution' technology in mid-1960s, 42000 varieties and 1,20000 strains of rice seeds. In West Bengal there were about 4800 varieties of rice. Today, not more than 450 varieties are found. It has been estimated that if we go like this then by 2006 only 10 varieties of Hyv will be used in 75% of our rice fields. Within the next 20-30 years 350 birds, 200 mammals and about 25000 plants of the world will be on the verge of extinction. In India 1500 species of plants and animals are threatened with extinction.

In many countries of the third world fish is a very important resource for protein and living for poor coastal people. The traditional fishermen never did over-fishing and they followed the ecological principles from their practical ecological knowledge. The nests that they used had large holes so that only larger fishes were caught in the net and not the spawns. So, the breeding grounds of the fishes were not destroyed. Local materials were used to make the net, boat and other equipment needed for fishing. The fishermen were self-reliant and the village community were involved in various works related to fishing.

But the modern drift net trawler fishing undertaken by outside business people for profit is endangering the fish bio-diversity due to over-fishing. This is jeopardizing the life and livelihood of millions of poor fishermen of the third world.

Air

The three other most dangerous effects of industrial civilization and gluttonous consumerism of rich elites of the world are global warming, ozone hole and acid rains. All the three effects are due to atmospheric pollution. The key to modern civilization is energy production. Most of this energy comes from the burning of fossil fuels. This causes release of carbon dioxide in atmosphere. The first world releases about 75% of CO_2. Every year about 6 billion tons of carbon is released in the air. This is a green house gas causing global warming and climate change. By the end of this century earth's temperature may increase by 3°-4°C. This will cause melting of ice caps in the poles and of the glaciers. All the glaciers of the world are receding. Sea water may rise because of melting of ice and expansion of ocean water. Low lying areas of the world will go under water. The greatest danger that is caused is climate change. After the signing of climate change convention of Rio in 1992 International Panel of Climate Change (IPCC) has met several times to reduce green house gas production. The Kyoto Protocol of IPCC decided that the industrialized countries will reduce the CO_2 emission by 5% below the 1990 emission level. USA did not sign the Kyoto Protocol. The CO_2 emission of USA and Japan is rising every year. European Union countries are sticking to the norms, more or less, set by Kyoto Protocol.

The most dangerous aspect of global warming is its impact on thermohaline circulation. In the 1980s there was a sudden slowing down of this circulation which maintains global temperature balance. This happened 10800 years back when there was catastrophic environmental impact. Moreover climate change may endanger the thin layer of phytoplankton on the surface of the sea which produces 70% oxygen of the earth.

During the last 10-15 years the ozone layer of the atmosphere has been depleted by 4-5% between the latitudes 40°-50°. Ozone layer absorbs greater part of the ultra-violet (U-V) ray that comes from the sun and allows only a small percentage to reach the surface of the earth that helps in building vitamins in human body. Exposure to excessive U-V ray causes deadly skin cancer called melanoma and cataract of the eye. During the last 50-60 years .2 million people have died from melanoma. Skin cancer in USA is increasing at a rate of 4-5% each year.

Ozone depletion is caused by chemicals like chlorofluorocarbon (CFC) and halons that is used in fire extinguishers. CFC is used for refrigeration, aerosol, paint and other industries. One chlorine molecule from CFC released in atmosphere can break up about 100000 molecules of ozone. Hence agreement has been reached in Montreal Convention in 1987 to phase out CFC production. Alternative to CFC for refrigeration has already appeared in the market.

Rachel Carson in her book `*Silent Spring*' written in 1960s described the environmental effects of acid rains. Acid rain is caused by the industrial gases like sulphur dioxide (SO_2) Nitrogen Oxides (NO_x) and fossil fuel gases which combines with water molecules in atmosphere to form acids like sulphuric and nitric acids. Industries in Western America causes acid rains in South East Canada and North East America. When acid rains fall on earth it harms soil, biodiversity and water.

Wastes

The modern consumerist industrial civilization creates mountains of wastes of which a large percentage is hazardous. In 1994, USA produced 200 million tons of wastes annually. If all these wastes were loaded in garbage trucks it will girdle the earth 8 times. There are 40000 landfills in USA, 55000 in Europe. By 1978, 15000 land fills were already filled up. In Newyork everyday 22000 tons of garbage is created.

American industries alone creates 560 million tons of hazardous wastes every year. It is about 2 tons per American.

There has been a Chemical Revolution in the Western World. To cite an example, in 1930 the total production of organic chemicals was one million ton. In 1990 it became 500 million ton. Every 28 years total chemical production is doubling. The liquid wastes from industries are dumped into lakes, rivers and oceans. Of the hazardous wastes the most dangerous are the nuclear wastes. Every year thousands of tons of nuclear wastes are created all over the world. Moreover, the early nuclear power stations are being decommissioned. Scientists do not know yet how to protect future generations from nuclear radiation and hazards from such highly radioactive wastes. Chernobyl and other accidents in nuclear power plants and the atom bombs in Hiroshima and Nagasaki always reminds us about the holocaust that atomic energy produces.

Y.A. Sakolov, Deputy Director General of International Atomic Energy Agency said in a world conference arranged by International Atomic Energy Agency (IAEA), 'By 2010 we need to demonstrate that the most pressing problem of waste disposal has been addressed or we will continue to have a pessimistic image of nuclear technology'.

It is the rich and the affluent of the world that creates the environmental destruction that has been described above. A baby born in America represents twice the environmental impact for earth as one born in Sweden, three times one born in Brazil, 35 times one in India and 140 times one born in Chad, Rwanda, Haiti or Nepal.

Ecological Foot Print (EFP) is the total area of the planet that humans require for agriculture, grazing, timber production, marine fishing, infrastructure together with the area required for absorbing Co_2, produced by humans by respiration and by burning fossil fuels. Already EFP has exceeded the regenerative capacity of earth by 20% since 1980s. If the world goes like as at present then by 2050 EFP will be twice the regenerative capacity. Earth has about 11 billion ha. Of productive land and sea space which is 1.9 ha. Per person. World's average EFP in 1999 was 2.3 ha/person which is 20% more than the biological capacity. But the EFP of an average African or Asian was only 1.4 ha per person in 1999, European EFP is 5 ha. Per person and for the Americans it is 9.6 ha. Per person. Living Planet Index has declined since 1990 by 55%. If we consider the least developed countries then their EFP may be .5 ha. or still less. We know that majority of world's population, about 4.8 billion, live in the third world countries. Hence it is not the population that is the root cause of environmental destruction in the whole world. It is the lifestyle of the rich and affluent of the world that is causing this devastation. Mahatma Gandhi and Rabindranath Tagore understood the dangers of industrial and technological societies. Mahatma Gandhi wrote "God forbid India should ever take to industrialization in the manner of the West. A tiny island kingdom is today keeping the whole world in chain. If an entire nation of 300 million took to similar kind of economic exploitation the whole world will be bare like locust." We can understand today that if India, China, Indonesia and the earstwhile USSR with 2.5 billion population decide that they will put an EFP of 9.6 ha per person then the whole world will be "bare like locust" within 10-20 years.

Rabindranath Tagore also warned the world in a similar manner. In a lecture in 1924 in China Tagore said, "We have for over a century been dragged by the prosperous West behind the chariot, choked by the dust, deafened by the noise, humbled by our helplessness, and overwhelmed by the speed. We agreed to acknowledge that this chariot drive was progress, and that progress was civilization. If we ever ventured to ask "progress for what and progress for whom" it was considered to be peculiarly and ridiculously oriental to entertain such doubts about the absoluteness of progress. Of late, a voice has come to us biding us to take count of not only the scientific perfection of the chariot but also of the depth of ditches lying accross its path".

It is necessary to understand why the world came to such a pass. Three important social upheavals took place in the 15th. and 16th. centuries. They are renessaince, exploration and discoveries and the Scientic Revoluation. In renaissance man become the measure of all things which is wonderfully expressed by Shakespeare in his immortal lines in Hamlet when he says -,

> *"What a pice of work is man*
> *How noble in reason*
> *How infinite in faculties*
> *In form and moving how express and admirable*
> *The paragon of animals*
> *The beauty of the world".*

This is perhaps an anthropocentric view of the world so different from that of Seatle Chief, the American Indian, who wrote that wonderful letter in mid – 19th. Century in reply to the then President of the United States' proposal to buy their land. Anthropocentric attitude was further strengthened by the philosophical attitude of the scientific revolution.

Exploration and discoveries by the Europeans for two hundred years since Columbus who discovered America led to the unprecedented plunder and eventual colonization of a large part of the tropical world which is the present day third world. Columbus expressed succinctly the purpose of exploration in his writing "Gold is the most precious of all objects in the world, as also the means of rescuing their souls from purgatory and restoring them to the enjoyment of paradise" Colonial world provided the primitive accumulation of capital. Colonial counitries became the captive markets of goods from the newly emerging capitalist countries. Industrial Revolution came in England between 1760 and 1830. The world starts changing very fast. The productive forces could sustain a large population. In 1830 there was only 1 billion people on earth after about 7 million years of evolution from when bipedal Australopithecines arrived on earth. By 2000 AD 5 billion more people were added. The lifestyle of the rich of the world changed that has been described earlier.

The seed for this new outlook towards nature was sown during the 17th. Century when the Scientific Revolution matured. The two codifiers of modern scientific method were Francis Bacon and Rene Descartes. They talked of acquiring the fruits of science, conquring nature and becoming the masters of nature. The scientific method that Descartes gave was to break a phenomenon into simpler parts and to study it. This method gave birth to a reductionist world view of looking at particular. The danger of this reductionist science was understood by many thinkers. The exponent of communist philosophy Friedrich Engels wrote in `Anti Dupring' "The analysis of Nature into its component parts were the fundamental conditions for the gigantic strides made in our knowledge of nature during the last 400 years. But the method has left us a legacy of the habit of observing natural objects and natural processes in their isolation detached from the vast interconnection of things'.

The scientific method introduced by Bacon and Descartes had helped us to understand nature and natures' proces but the same world view today has brought the world of nature and society at the brink of a disaster. It is as if the "negation of negation" of dialectical materialism. The reductionism that helped us to understand nature and nature's laws, today the same tunnel vision, forgetting the vast interconnections of things, is bringing ecological disaster.

The famous 17th. Century mathematician and philosopher Blaise Parcal wrote "Humankind is a small link in the immense Web of Nature, but is only one that, through thought understands nature. It is the only species on earth to be responsible for the earth, and to be able to transform it, for better or for worse". Karl Marx in his, 1844 "Economic and Philosophic Manuscript" wrote "Nature is the inorganic body of Man.... But no, nature is not the inorganic body of man alone, but as well as that of the bee and the royal eagle. Paraphrasing Hugues de Saint Victor I would even say that he who loves mankind is only a tender neophyte; better is he who loves the other living species as his own. Only perfect is he who recognize in his own body the inorganic body of nature."

The economic and political philosophy that Marx propounded is opposed to the holistic view of Pascal and Marx described above. Marx wrote in `Communist Manifesto'. "The proletariat will use its political supremacy to wrest by degress all capital from the bourgeoisic, to centralise all instruments of production in the hands of the State, i.e., of the proletariat organised as the ruling class, and to increase the total of productive force as rapidly as possible". Joseph Stalin in his book "Economic problems of socialism in USSR', written just before his death, wrote, "The securing of the maximum satisfaction of the constantly rising material and cultural requirements of the whole of society through the continuous expansion and perfection of socialist production on the basis of higher techniques". We find that the builders of communism also talk of continuous expansion of productive forces to satisfy material and cultural needs. We have shown what kind of devastation the industrial society is bringing today.

Alternative planning

We have to recognize that the temperate and tropical world are different. In these two worlds soil, rainfal, wind and polination characteristics are all different. Soil in tropics is poor in organic content because organic matter decomposes under the impact of high humidity and temperature including high microbial activity. In the temperate region organic matter status is high.

Tropics have torrential rainfall for a few months and then a long dry spell. Soil becomes perched and form hard cakes. It erodes easily and very fast in the next heavy rain causing severe soil loss. In the temperature region rainfall is even throughout the year.

In tropics winds are fitful but generally low except in coastal region, foot hills and hurricanes. In temperate region wind is normally of high velocity.

The pollination characteristic is also different in two region. In tropics it is mostly through insects and birds. In temperate regions it is mostly through the wind.

Hence we find that tropical ecosystem finds stability through a much longer chain of interconnections. Hence, nature conquering technology has much more disrupting effect over a much wider spectrum in tropical countries compared to temperate regions. As for example, when Green Revolution technology is used in India with pesticides, weedicides and herbicides it is more devastating than when used in temperate countries.
Rabindranath Tagore raised question about `progress'. What

shall we call progress? Today, those who are speaking about an alternative paradigm of development they have a different definition of progress. They are progressive but not progressivist. The new paradigm of development does not recognize that the `development of productive forces' controls or advances all other developments. It refuses to accept the priority of productive forces. It posits productive forces under the social relation and the world view that geenrates that relation. This philosophy tests the relationship between man and nature keeping confidence and respect on human, future generations and even other animate and inanimate matter as referred by Marx and Pascal quoted earlier. This new philosophy is not the story of unilinear development. If history had any inner dynamic mobility then it would follow the law of thermodynamics. Hence, it would have been such a history that the entropy would have continuously increased. Then it would have been a history of decay. Only self concious human mind can stop this decay or overturn it. So, political ecology describes development as a tendency. One can define these tendencies as ethics and aesthetics like equality, community feeling, sovreignity, sense of responsibility, democracy, adjustment, harmony, peace, security and other values.

From the analysis that have been made in previous paragraphs it is clear that there has to be fundamental change in economy so that there is an equal distribution of income, economic power and wealth, both in the first and the third world, and there is an end to the madness of glutttonous consumerism. If this is done then the industrial production will decrease and there will be reduction of the wanton use of natural resources for inconsequential purposes. The developed and the rich people of the world would not alter their lifestyle by itself. If this has to be achieved a new kind of unity has to be made to change the world. Signs of this unity is seen in the World Social Forum in which thousand of people from the North and South congregrate with a bold faith that

"There is an alternative". They are united against the rule of capital.

The present writer is convinced like Thomas More in `Utopia'. "I am quite convinced that you'll never get a fair distribution of goods or a satisfactory organizing of human life until you abolish private property altogether". All over the world a society has to be established which is based on justice, equity and self reliance. The economy and polity has to be decentralized. The ideal of the new society will be the maximum satisfaction of the cultural needs of man as opposed to the consumenist lifestyle. This is where the humans differ from other living species. It is necessary to define need. We have to remember Gandhijis words "Nature has given man enough to satisfy its need but not enough to satisfy its greed".

It is necessary to return back to the marginal people of the third world their right to land, forest and water. The industry will produce goods which are essential need of humans. All humans have to be provided with adequate food, clothes, health and housing to lead a simple lifestyle. Countries have to reduce their dependance on world market system. In this way the use of natural resources in harmony with nature will increase. The third world countries will reject the useless consumer products, technology and industry which are not essential needs of humans and are unsustainable.

The basis cf alternative planning will be sustainable development. We have to reject that development which takes away the right to life of future generation. We have to use minimum of non-renewable resources. We have to widen the use of renewable resources like solar and wind energy and organic resources. We have to generate that faith and confidence that it is possible to establish a society in the third world which is ecologically sustainable but very rich from the cultural and aesthetic point of view. There are many communities in the third world who sustain themselves from five natural resources – forest, land, water, biodiversity and air

– and using their labour power. They live in harmony with nature. Their need is very little. We have to rediscover their traditional wisdom and acknowledge their agriculture, housing, use of water and indigenous technology. We have to add new dimension to all those traditional knowledge. It does not mean that we should have a romantic and irrational view of all that is traditional. We have to discard all obscurantism and exploitative system. But there still exists traditional knowledge, technology and system in the third world which is relevant to sustainable living and development. All such traditional knowledge has to be recognized. We have to save them from so called modernism. Whenever a technolgoy is discovered it is necessary to ponder if the same has any deleterious effect in ecology and society.

It is necessary to cultivate parallel culture right from childhood as opposed to the stereotype modernism that we witness in media today. This alternative will not come in a day or by itself. For this it is necessary to organise all suffering and working people and struggle for a new sustainable society. Constructive activity should go hand in hand. Many voluntary agencies and NGO bodies are doing wonderful work in agriculture, water harvesting, education, health and housing construction at the grassroot level. In this connection the work of Anna Hazare at Ralegan Siddhi and Pani Panchayet in Maharashtra, Tarun Bharat Sangha at Alwar in Rajasthan and many others may be mentioned. It is necessary to start such constructive works in rural and urban areas without waiting for social revolution. The constructive work is also a struggle for a new society. So, struggle and construction have to be the programme for a future society.

Handling Solid Waste for Disposal

Satyesh C Chakraborty

Introduction

The largest number of social protests against pollution of environment is related to generation and disposal of wastes. Almost all managers of environment, be he placed within the Ministry of Environment & Forest or in a municipality, are required to deal with such social protests or the causes of those in one way or the other. We shall examine in this essay the options that our manager of environment may enjoy with regard to generation and disposal of solid wastes. No distinction will be made between domestic and industrial waste to keep the canvas manageable.

It is true that there exist today a large variety of technology to treat and handle wastes. It is also true that unless the society agrees to accept the proposed technology, the manager would fail to secure their support and mobilize their participation in solid waste disposal. Under such circumstance, our manager would appear ineffective. Most societies are found to be oriented in some peculiar manner in their acts to generate wastes and to dispose those off. These are the products of some social processes acting over time. Unless our mangers of environment appreciate this process and select the strategies accordingly, social acceptance of the proposed system would be difficult to obtain.

Some Observations on Social Conditioning

Perhaps a few short comments on how the diverse social processes influence managerial options for waste disposal may be useful to hold the objective of this essay in sharper focus than say by picking up a specific technology and discuss its utility without reference to the objective reality confronting a given society. This preference for looking into the social processes is given by the fact that most discussions on waste management are initiated in terms of relative efficiencies of different technologies even when it is understood that no technology can establish managerial effectiveness unless it is appropriate within the given society. Since we are proposing to pursue an offbeat path, stating the obvious at the risk of being labeled as platitudes may be found useful as a starting point of this discussion.

All human actions dealing with production and consumption of material goods lead to creation of waste. The basic reason is that the specific ingredient that is sought after, say by an individual or an industry exists in nature mixed with other undesired substances. The parts seen useless in the context of the objectives of the actors are rejected and discharged as wastes. This is how vegetable peelings, offal of animals, scales of fishes, spoilt food, old newspapers, outdated telephone directories, empty tooth-paste tubes, empty bottles of beverages, cut-out cans, ruined household wares, broken vehicles, outmoded industrial machineries, ore gangues, iron-slag, burnt out coal ashes, etc., appear as junks worthy of being discharged as wastes. From this perspective all wastes are seen as materials having no obvious utility.

However, we need to recognize that the utility of any substance is generally revealed through the accounting of cost and benefits. At least that happens with persons motivated to seek economic gains and to avoid losses. The given accounting system helps us to identify what is useful as against what is useless to retain or pursue. If we modify the given accounting system, say by admitting the financial responsibility of waste disposal, then it may be possible that we shall find discarding everything as waste as not quite bright an idea. By changing the accounting methods, we may discover economic values in some of the objects discarded earlier as waste. The point to appreciate is that changing the accounting method becomes unavoidable as the social processes create new conditions for economic efficiency.

We first may look at one widely manifested change that is caused by social processes. The rule of economy that governs the procedures of cost-benefit analysis also stimulates a process leading to increasing agglomeration or clustering of activities within small tracts. We start getting congregations or clustering of diverse economic activities within small tracts to get advantages of easy contacts between enterprises. This is how urban centers are formed. The same process creates the conglomerations of urban centers (called conurbations) and industrial agglomerations. All such congregations produce crowding effects, placing competitive demands upon limited supply of land, water and other environmental resources. The consequences are the rising prices of land leading to fast disappearance of vacant land and consequent shortages of sites to dump wastes. Consequently, the people, offended by random discharge of wastes, start protesting. Social consensus about the offence gets heightened, leading to political pressures being put on the managers of environment to deal with the problem. Normally such pressures originate where the crowding effects are most pronounced. Such political pressures lead to the establishment of some institution charged with the responsibility to clear the objects of offence. The nature of the pressure envisages the type of institution required.

This leads to acceptance of the political pressures to clean up the offending wastes and agreements to meet part of the cost. However, the solution of the problem of waste disposal does not come that easily. The presence of public pressure is certainly an advantage. But to deal with the problems of pollution in tracts with crowding of activities, public pressure does not reduce the complexities of the task. Long before we had our modern day managers of environment, the problem of offending accumulation of wastes were emerging within the urban-industrial agglomerations. The offended societies had taken steps to create the institutions of local government, like urban municipalities, city municipal corporations or notified area authorities, and by entrusting these to run conservancy services in cost effective ways.

These institutions, being sensitive to the economic norms of cost-effectiveness, had laid infrastructures mainly of the nature of over-ground or underground conduits to carry sewage with or without rainwater passing through the same conduits. These have set up common dumping grounds for disposal of all kinds of solid wastes. Such systems of conservancy service have succeeded in transferring the locations of the offence from within the urban centers to the out falls of untreated sewage and to the common dumping grounds located generally on the peripheral areas. The net effect of such choices has been substitution of one set of suffering residents by another. Pollution *per se* persisted. We may incidentally mention that the illustrated situation is rather similar to that prevailing in the City of Calcutta and many other cities of India.

Availability of technology to handle waste poses the least problem. At any given moment one can lay hands on many types of technology that are in use in one or the other part of the world. The problem lies in the selection of a technology that would be cost effective to deal with the type of waste generated by a given situation. However, some general rules do identify the basic attributes of the historical experience of waste handling. By following these rules one can identify the required technology to deal with the waste generated by a given society. The very first rule is that the more heterogeneous the composition of the waste is, the more complex and expensive are the required plants and machineries. This promotes a policy for separation of the different types of wastes at their sources to cut down costs of processing by homogenizing waste. The second rule is that the larger the volume of wastes the greater is the opportunity derivable from the use of large scale of operations. This rule promotes a policy in favour of centralized handling of wastes.

These two rules together bring to surface a problem of altogether different kind. The manager has to integrate the decentralized source-separation methods with large-scale centralized operations. It is a difficult issue to resolve. But, if the manager of environment keeps an eye on the emerging social processes, he may discover some opportunities to his advantage. We may get back to the rules of the economy to appreciate this.

The rules of the economy become elaborate over time and a stage comes when the individual entrepreneurs find it increasingly convenient to off-load their peripheral activities and to concentrate on the core fields of engagement. One part of the explanation of this process is that the production processes are becoming increasingly elaborate, each component of which demands application of specialized art.

Managerial costs of handling one set of specialized art can be affordable. The cost of handling too many specialized arts under one roof increase disproportionately. However, narrow specialization normally does lead to marketing of assembled goods demanded by the larger society. What the society wants is a complete apparatus, not a part of it. Therefore, the process of increase in the order of specialization can be sustained only when the other enterprises produce the other components and agree to supply those to an enterprise enabling it to assemble a product that is liked by the given society. Thus a comprehensive and integrated system of production emerges to sustain the members composing that system.

Our manager of environment, faced with the situation described above can hope to resolve this problem of organizing source-separation of wastes by persuading the society to comply with the imperatives of the chosen technology. Application of force for such compliance can be avoided in some societies by allowing the separators of wastes to sell or use the recyclable components. Such an option is available when, through successful elaboration of the principle of division of labour, the economy achieves vertical and horizontal integration of enterprises, where each enterprise deals with only a small part of the total chain of fabrication of materials and uses the output of other enterprises. The recovered recyclable materials can easily fit into such an economic system.

Within such a reality, even a specific component of waste generated by one enterprise can be used with profit by some other enterprise. This permits the society to gainfully use the technology of source-separation of wastes, to reuse the selected materials, to conserve material resources for the society at large and to simplify the processing of the residual wastes. The manager of environment has to understand the emergence of this reality and select his technology of waste processing accordingly.

Character of Waste of the City of Calcutta

Having described some of the features of historical transformation of societies and their impacts on the choice of technology for waste disposal, we may now speculate, by way of an illustration, on what technology of waste disposal would be suitable for the City of Calcutta. Here the citizens are generally dissatisfied with the quality of service that the Municipal Corporation of Calcutta provides for solid waste disposal.

It should be stated in the very beginning that any statement on the prevailing situation in the city would be based on only a few general information that is available. More detailed information is required to fine-tune the choice of technology. The latest reports on solid waste management in Calcutta are mainly based on a study carried out by the National Environmental Engineering Research Institute (NEERI). On account of changes in economy and demography, the volume as well as character of garbage has presumably changed by now. For such uncertainties in the database, it would be wise to refer to the main issues and tendencies on the waste generated in the City of Calcutta.

It is estimated that altogether around 3,100 to 3,150 MT of wastes are generated every day in this city. The private households are the leading sources of daily waste that originates in this city. This source contributes more than 50% of the total waste. The industrial wastes, explaining about 18 % of the total waste hold the second place. Closely follows the volume of waste from trading, commercial and institutional sources, accounting for approximately 13% of the total. Although clinical wastes contribute only 2%, its content is generally toxic. This is presented in **Table – 1**.

Table - 1: Quantity of Waste Generated from the City of Calcutta (1993)

Source of Waste	**Wet Weight in Ton per day**	**Percentage**
Domestic Waste	1668.74	53.8
Industrial Waste	563.00	18.2
Trade / Commercial / Institutional Waste	412.26	13.3
Clinical Waste	66.15	2.1
Others (Construction, Slaughter house, hazardous waste)	389.85	12.6
Total	**3,100.00**	**100.00**

Source: Calcutta Municipal Corporation, 1993

Table – 2 shows the results of physical analysis of the waste of Calcutta as of 1970 and 1993. The changes in composition between the two dates are clear. From the observed features of the changing economy of Calcutta, it is permitted to assume that the loads of plastics, paper, metal and glass would be increasing. A decline in ash generation is noticeable due to the large-scale use of new fuels like kerosene oil and gas as replacements for wood and coal. However, a high ash content in the wastes of Calcutta is to expected to continue in future, because a substantial part of the residents do not have access to modern systems of cooking (CMC, 1993). Organic contents in the household waste are expected to grow due to population growth. However, that would not materially alter the share of this sector in the generated wastes.

Table – 2: Changing Composition of Wastes of Calcutta

Types of Wastes	**Components**	**Estimated Percentage by Weight**	
		1970	**1993**
Vegetable and Putrefying Fractions	Leave	13.05	14.2
	Straw	6.31	4.4
	Garbage	16.05	16.2
	Coconut shell	4.96	6.2
Total		**40.37**	**41.00**
Combustible Fraction	Paper	3.18	5.2
	Plastics	0.65	3.5
	Textile, Rags	4.2	2.9
	Bones	0.42	0.45
Total		**8.45**	**12.05**
Non-combustible Fractions	Ash & Silt	33.6	27.0
	Earthen ware	6.65	8.5
	Stone	1.33	1.5
	Coal	8.08	6.5
	Glass & Metal	0.66	1.45
	Leather & Rubl	0.86	2.0
Total		**51.18**	**46.95**
Grand Total		***100.00***	***100.00***

Source: Calcutta Municipal Corporation, 1993

Chemical composition of the waste of Calcutta is conspicuous for high moisture content, high share of organic matter, low calorific value and very high carbon/nitrogen ratio. These are shown in **Table – 3**. In addition to the physical and chemical properties of the wastes of Calcutta, it is necessary to note some other associated features in order to understand the problems of waste management. In the first instance, mention should be made of high annual rainfall, especially in the monsoon season, coupled with sluggish drainage. These two factors together make the solid waste very wet, which the experts describe as semi-liquid. It has also been observed that the volume of generated waste from the city varies between seasons, becoming higher during winter season. The reason is availability of larger varieties of vegetables in winter in large quantities. Next important factor to note is that, due to economic differences, significant variations in the quality and volume of waste obtain between the rich and the poor residential neighbourhoods. The rich generate more wastes per capita, in which paper, plastics, glass etc., are found in larger quantities, compared to the poor neighbourhoods. In other words, daily generation of waste differs between different localities. Another problem to mention is the mixture of solid waste and human excrement due to the insufficient sanitation system.

Table - 3: Average Chemical Character of the Waste of Calcutta

Item	% by weight
Moisture content	41.11
Organic matter	35.24
Nitrogen	0.55
Phosphorous as P_2O_5	0.58
Potassium as K_2O	0.41
Carbon C	19.58
ph value	7.31
Calorific value (B.T.U. / Lb)	2 707.70
C / N ratio	37.41
Compression ratio	1.5 to 1.8

Source: Calcutta Municipal Corporation, 1993

Taking together all the information on the character of solid wastes of Calcutta as given above, following observations on the problems of solid waste management can be made:

- Due to low calorific value and high moisture content, hardly any possibility exists for Calcutta to run a waste incineration plant successfully.
- The hospital wastes, as an exception, can be successfully incinerated.
- A pre-condition for effecting an efficient disposal of wastes would be proper separation at source of all recyclable or usable items (such as paper, glass, metals, plastics, batteries etc.) and their immediate transfer to the appropriate entrepreneurs.
- Given the general character of the waste, the best option appears to be the production of manure for farming.
- Before composting, the non-putrescent items must be recovered through intensive sorting, which would be expensive.
- Avoiding the chances of environmental pollution now or in future, the residual part of the waste may be dumped.

Table - 4: Estimates on Waste Generation and Collection from Calcutta

Items	**Year**	
	1991	**2001**
Estimate of generated waste in ton/day	3100.00	5225.00
Collected waste by the Municipality (%)	70	?
Private entrepreneurs	10	?
Uncollected	20	?

Source: ILGUS, 1991

Table – 6: Annual per Capita Consumption of Paper in Some Countries

Country	Status	Average paper consumption (kg / capita / year)
India	Developing	3
Japan	Developed in Asia	234
United States	Developed in America	298

Source: Van BEUKERING, P. and A. DURAIAPPAH, 1996

We may now turn attention to a universally used material called plastic. The economically advanced societies are the big consumers of plastic. Plastic has come also to India and is likely to stay for the convenience that the consumers derive from its use. Per capita consumption of plastic in India, for obvious reasons, is very much higher in the cities than in the villages. In Calcutta, consumption of plastic is daily increasing much to the annoyance of the municipal government. These are not easily degradable and the dumping ground is littered with it. Careless use of plastic bags is choking the sewage lines. In many quarters of the CMC, therefore, the idea of prohibiting the use of plastic has been aired. However, every sensible person knows that the citizens would disregard such prohibitions. Plastic has come to stay, not only in India but also in all countries of the world. Sensible researchers believe that in India there shall inevitably be increased use of plastics. One such estimate is presented in **Table – 7.**

Table - 7: Estimated Demand for Plastic in India (in tonnes)

Type of Plastic	1991	2000
Low Density	1,75,000	7,00,000

Polyethylene (LDPE)		
High Density Polyethylene (HDPE)	50,000	N.A.
Polypropylene (PP)	75,000	4,20,000
Polyvinylchlorid (PVC)	2,40,000	748,00,000
Polystyrene (PS)	35,000	1,20,000

Source: VENKATESWARAN, S., 1994

Not only would plastic consumption increase, the use of paper would also rise. This is estimated in **Table – 8**. The deficit would presumably be met through imports.

Table – 8: Projected Demand for Paper Products in India around 2000
(in hundred thousand tonnes)

Paper type	Demand	Production	Deficit
Paper & Paper Board	37.90	27.70	10.20
News Print	10.80	7.40	3.40
Total	48.70	35.10	13.60

Source : VENKATESWARAN, S., 1994

The above information should suggest that the differences between the economically developed and under-developed countries exist not only in volume but also in the nature of waste. This is shown in **Table – 9**. In this table, the composition of waste for the Indian urban areas represents an average over 33 cities. The estimate for the First World has also been roughly assessed from a large number of cities. High content of paper, glass, metals and plastics in highly industrialized countries is one striking feature. Its counter point is that the wastes of India contain high proportion of ash or fine earth. These also contain matter that can be converted into compost. Such differences would certainly determine the effective waste disposal systems differently between the First and the Third World countries. The point is to ascertain what would be the best method for Calcutta.

Table – 9: Comparison of Physical &-Chemical Characteristics of Wastes (in % of total weight)

Characteristics	India *	Developed Countries
Paper **	3-7	20-50
Plastics **	0.5-0.9	1-3
Metals **	0.4-1.0	4-14
Glass **	0.3-0.8	3-10
Ash and Fine earth **	30-50	3-10
Total compostable matter **	30-50	10-20
Moisture content **	20-30	15-30
Organic matter ***	20-30	15-30

*Notes: * Mean Value of Data from 33 Indian Cities; ** On wet weight basis; *** On dry weight basis*

Source: VENKATESWARAN, S., 1994

A Search for an Appropriate Method

To establish some clarity in our objective, a set of simple syllogisms can be constructed by recalling features of the economy within which Calcutta is located. To begin, we may recall that the demand for paper and plastics in India would rise. This prediction would also be true for all recyclable materials that the waste of Calcutta contains. To meet this demand, there are two options before India. In the first instance, these materials can be imported. Alternatively, capacity of production of these materials within India can be raised. The first assumption would cause drain of the scarce foreign exchange reserve of the country. The second option would take time to materialize. Hidden between these two options lies two facts of great interest. One of these is that all natural resources are not well endowed in India, for example petroleum for plastic. Hence conservation of material is a commendable objective. That takes us to the issue of energy saving from recycling. The other one is that recycling uses less energy than what is necessary to extract the desired material from the natural sources. This is shown in **Table – 10.**

Table – 10: Energy Savings from Recycling

Type of material	**Energy Saving***
Magnesium	97%
Aluminium	96%
Steel and iron	65%
Plastic (polyethylene)	97%
Plastic (polymer)	92%
Rubber	70%
Glass (100% culled)	22%
Paper	60%

Notes: 1. These figures are based on techniques,which are applied in industrialized countries and cover the complete production process from " cradle to grave".

*2. After Powell, 1983: *Energy Savings from the Use of Secondary Material in Comparison to the Use of a Virgin Material for the Production of the Same Product (from extraction to manufacturing)".*

Source: van BEUKERING, P. 1994, In: BAUD, I. and H. SCHENK, 1994

Assume that nothing will be re-used or recycled. The inevitable consequence of this decision would require us to accept eventual burial under our own garbage. That would surely not be a pleasant prospect to welcome! One should also remember that some materials do not degrade easily in nature, for example, the plastics. Environmental consequence of permanency of dumped plastics can be easily guessed. It would perhaps be more rational to recycle plastics that to dump it for landfill. This is perhaps true for many other constituents of the waste of Calcutta.

As mentioned earlier, there are many different types of technologies available for disposal of urban wastes. Not all of those are equally environment friendly. The reason is that solid wastes from urban areas are extremely mixed in nature. Organic substances, glass, paper, plastic and metals of different types emerge as solid wastes. With the growth of the national economy and population in any given town, the solid wastes get composed of newer materials and appear in larger bulks over time.

One common technology of waste disposal is to dump these as landfill with or without any plan to extend built-up areas close such tracts. If used to promote built land use, the risks of contamination from toxic substances left in the landfill can be a potential danger. There are other problems with this technique of waste disposal. Commensurate with economic growth, price of land within the urban areas as also on their peripheries increase. This restrains the local government to acquire new tracts to dump wastes. Even if such sites become available, the neighborhood residents object to waste dumping. With the building up of awareness about environment pollution, solid waste disposal is coming under more stringent regulations than in the past. Therefore, the most common task of all local government organization is to discover the ways and means of reducing the bulk of wastes reaching the dumping grounds. This can be achieved only by reusing as much of available solid wastes as possible and by dumping only the unusable.

Municipal wastes, after all, contains many potentially useful items, newspapers, steel cans, aluminium foils, copper wire, glass, bottles and rubber tires can all be reused, either as is or after reprocessing. Food and vegetable wastes have potential value as compost. A wide variety of components, including paper, food, office wastes, and warehouse refuse can be burnt to make energy, a fact of great importance in a world of rapidly rising energy prices. At the same time, there are also considerable amount of unusable components in municipal solid wastes, like ashes from ovens. Therefore, the issue before the manager of environment, concerned as he is in the conservation of resources, is to select an appropriate technology to make use of the usable substances from the available solid wastes. This will also reduce the bulk of solid waste for landfill.

Technological barriers are probably the least serious obstacles to wider resource recovery in our present day world. The problem rests on taking a rational decision on what one wishes to recover and on what one wishes to put into use. Technologies of many types can be described only to show the potentials. For example, iron-containing items, like cans, broken household appliances, nails, screws, pails, drums, etc., can be easily removed from garbage by magnets. This technology for iron recovery is not new. Glass and aluminum can be recovered after incineration of the combustible elements. Even before incinerating, one may use shredding machines to tear garbage into inch-long pieces, magnets to extract iron and blowers to separate out the lighter and burnable portions (paper, plastic, food wastes, vegetable refuse, etc.) from the heavier glass, aluminum or copper and other non-combustible materials. In a centralized garbage collection point, shredders, blowers and magnets will have a residue that can be fed, together with coal, into boilers. Water pipes passing through the boilers can recover waste heat to produce steam to turn turbines to generate electrical energy. Alternatively, the residual organic material can be fed into anaerobic digesters, where bacteria would convert these into natural gas (methane) and sludge. The sludge and possibly the paper-scraps can be fed to earthworms and the earthworm castings marketed as soil containing valuable plant-nutrients. The other separated materials, like tires, plastics, metals, glass and papers can be re-used by the respective manufactures to produce articles for mass consumption. It has already been observed that recycling requires less energy than what would be needed to extract these from virgin materials.

We can certainly raise at this stage a very valid question on what scale of operation would the above-mentioned technological options be economically viable? The most straightforward answer would be that viability of any system would be higher for urban municipal population of large sizes. But, even with the largest city, the more pertinent question would be whether to accept source-separation and centralized recovery methods as mutually exclusive systems or whether these two can be made complimentary to each other.

Each approach has its advocates. Source-separation enthusiasts claim that their method is highly energy-efficient, because people rather than machines separate components; that it is easy to implement; and that the centralized systems are impractical and unreliable, because their massive size and technological complexity make them prone to breakdown and failure. The proponents of centralized system argue that it can provide a significant new source of energy and that source-separation is impractical and unreliable, depending as it does on cooperation from the lay public. Evidence is accumulating to suggest that the two approaches are not likely to be incompatible except, perhaps, in their extreme applications. No example of either method tackling hundred percent of generated garbage exists anywhere in the world, despite efforts taken by many cities. Reasonable mixture of both the methods is feasible depending on how the organizations are laid and maintained.

There are several issues to consider for organizing either centralized processing or source-separation methods. The first one of these is to decide what comes first, the new enterprise for solid waste management or the consumers of recovered and processed materials and energy. Especially in the context of source-separation, the second issue is to decide whether every household in a highly stratified urban society shall be equal partners in recovering reusable materials. It is an important issue considering that the inventory of consumption varies widely between the rich and the poor. Finally, there is the problem of getting cooperation of all relevant institutions on a project on major resource recovery. It is important to note that some types of wastes, like newspapers, bottles and cans are currently collected in many Third World cities by private haulers from the residential and commercial houses. There could arise a desire to integrate these vendors with the chosen system.

While each municipal government has to design its own style of operation in consonance with the specific situation prevailing in their respective towns or cities, there are a few basic instruments that all municipalities may gainfully use. The most important instrument that a municipal government can play with is the 'tipping-fee' that it can offer to stimulate the prospective entrepreneurs. To compute the affordable tripping fee one has to consider savings plus income minus incremental costs of waste handling. Here savings refer to the difference between the costs of hauling unseparated wastes and that for residual wastes after source separation from the different parts of the city to the dumping ground. It would also include the annual value of the additional dumping area to be purchased together with the cost of settling disputes under environmental pollution laws. This means that longer the average distance between the catchment area and the dumping ground is, the greater will be the savings from source separation system. Similarly, wider and intensive the order of urbanization in the surrounding region is, the grater will be savings from reduction of need for purchase of new and costly, dumping grounds and settlement of disputes. Similarly, income includes many things like revenue from sale of separated usable materials, processed materials (natural gas and castings of earthworms) and energy. Incremental costs of waste handling would include expenditure on account of collecting the separated materials plus subsidies for the processing plants, at least in the initial years.

Having computed the affordable 'tipping fees', the municipal government has to decide on how many different ways should it use this fund to stimulate the different entrepreneurs, who are now seen as partners in a major project. In the context of adopting source-separation system, the required stimuli may appear in the form of

- free supply of containers with multiple compartments or disposable bags to the waste generating household or institution;
- setting up of local and/ or central deposit-booths for reusable materials;

- offering standardized prices for the reusable materials brought in by the residents to the local or central deposit-booths;
- Securing market for the recyclable materials;
- Subsidizing the bio-digester plants located at or near the dumping grounds for the organic wastes;
- Securing market for the outputs for the bio-digesters, and
- Building up of citizens' awareness development programs.

It is obvious that each city-government will discover differential opportunities to make use of the existing systems of disposal of reusable materials, say, by way of mobilizing the cooperation of private haulers of newspapers, glass, etc. Similarly, we may not expect all city-governments would find local market for all the recoverable and reusable materials. All these will only highlight the importance of decision making on allocation of funds for selection of the objective of stimuli and for organizing the required support system(s). This would also suggest that no prototype or model will apply equally well across all urban centres. Each city has to discover the model that would suit the reality obtaining therein.

Let us now identify the issues, which a city government has to consider in order to take decisions on the allocation of financial stimuli in the event of going in for centralized processing system. We may recognize that in such cases the computation of the affordable 'tipping fees' will have to be done in response to the technology chosen for processing garbage and producing marketable materials or energy. For example, the centralized system may wish to separate out all reusable materials at the site. In that case, no incremental cost of source separation will be incurred. No price for the garbage is also required to be fixed. Instead, the revenue generated from the sale of products would have to be taken out of the total cost of operations and the difference has to be met against the affordable 'tipping fees', which will consist exclusively of the annual savings derivable from the reduction of demand for purchasing additional dumping ground plus the costs of settling environmental disputes. If the central processing plant wishes to make use of partially separated garbage, then some of the elements considered in the context of source-separation system will enter in the computation of affordable 'tipping fees' and its allocation as stimuli.

We may note that there are two basic processes available for centralized system to utilize. In the first instance, there is the technology of incineration coupled with waste heat recovery. Here the trash is burnt in furnaces having screens of water pipes absorbing waste heat. The steam can be reheated with coal using boilers to turn turbines to produce electricity. The size of such units can be made big of small to suit the amount of available trash for burning. The ash is then used for landfill. Efficiency of heat recovery, it may be mentioned, is greater with large size units. The second technology converts a major portion of the trash to a fuel that can be burnt not only in incinerators, but also in standard industrial boilers and domestic ovens. These fuels are known as refuse derived fuel (RDF). One can produce 'wet-RDF' by reducing all wastes to a wet pulpy mass, which is then fed into a centrifuge to separate the higher fraction for partial drying and burning in specially designed boilers to produce energy. One may also produce 'dry-RDF', which is transportable for burning in the different types of boilers or ovens already existing in the locality. However, dry-RDF' is highly inflammable and subject to spontaneous combustion, which suggests that it should not be made to travel over long distances.

It is clear that there exist a large variety of options for a local government to match the given reality of a city with the available technology. There certainly is the need to match the chosen technology by an appropriate organizational support system. However, many of the local-governments will not be able to take advantage of the options available within their own resources, be it financial or legal powers, unless provided with additional supports coming from the government. There are several issues for us to consider.

In the first instance, there is the problem of organizing the game of exploration of the available alternative technologies. Most of the institutions of urban government do not always have the appropriate unit to conduct this business of exploration. They will need help and such help may come, say, from grants to set up the required planning machinery and to hire the services of experts in the relevant fields of technology. Secondly, the transport tariff rates are generally unfavourable to move recovered reusable materials. Often it is less expensive to transport virgin materials. Therefore, some of subsidy on transport is necessary, including revision of tariff rates. Third, even the most appropriate technology may remain beyond the reach of a given urban government unless financial assistance is given. This help would be needed to cover capital costs. But all subsidies on revenue expenditure must be accommodated within the affordable tipping fees that a given urban government would be able to mobilize.

Two legislative instruments appear relevant here. In the first instance, the urban governments may recognize the advantage of substituting the current principle of charging consolidated property tax by the principle of service taxes as distinct from property tax. This may help the respective urban governments to generate some revenue through levying conservancy service fees. This may be made proportionate to the value of the given property irrespective of the use made of it. If the utility of this instrument is recognized, then the given urban government may wish to apply a second instrument, that of levying a surcharge on conservancy service fee upon those organizations which generate conspicuously large volumes of waste and/or hazardous materials. Both these instruments are extremely sensitive to organize social participation in waste disposal. These are discriminatory in character and can, therefore, be made to reflect the diverse facets of urban waste generation processes as sustained by different industries or social groups. Non-discriminatory or indirect tax instruments, on the other hand, are unsuitable, because those who do or do not produce litters will be subjected to paying tax, say, in the event of imposing a national litter tax. The utility of fixing discriminatory fees becomes clearer when seen against types of materials to be disposed as industrial solid wastes. To sate in simple terms, the more hazardous the material is the higher would be the discriminating fees.

Sources of Data Used

1. Calcutta Municipal Corporation (CMC), 1003 Solid Waste Management of the City of Calcutta, India: a project report on promotion to informal waste recycling & reuse, Calcutta 1993

2. ILGUS, 1991 Bulletin of the Institute of Local Government & Urban Services, Calcutta

3. BOSE, A. and I. BLORE, 1993 'The Economics of Solid Waste Management in Calcutta', Nagarlok, Urban Affairs Quaterly, Centre for Urban Studies, The Indian Institute of Public Administration, New Delhi, India, Vol. 25,No 2, p32.

4. Van BEUKERING, P. and A. DURAIAPPAH, 1996 'The Economic and Environmental Impacts of Waste Paper Trade and Recycling in India: a material balance approach', Collaborative Research in the Economics of Environment and Development (CREED), Working Paper Series No. 100, November 1996, Amstredam, London.

5. VENKATESWARAN, S., **1994 The Wealth of Wastes:– waste pickers, solid wastes and urban development**, Friedrich Ebert Stifung, Germany, New Delhi

6. Van BEUKERING, P. 1994, in **Solid Waste Management: modes, appraisals and linkages in Bangalore**, by BAUD, I. and H. SCHENK, 1994, Bangalore.

Ecology, Economics and Sustainable Development

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Ecology, Economics and Environment

The word ecology owes its origin to the Greek *oikos* , meaning *"household"*, combined with the root *logos* which means "the study of". Thus, ecology is the study of households where households include plants, animals, microbes and people that live together as interdependent beings on the planet Earth. In the broader sense, therefore, ecology is the study of the relationship of the living organisms with the nonliving materials in the surrounding environment.

The word Economics is derived from the same root, *oikos,* (households), as is the word ecology. Since nomics means "management", economics translates into the study of management of households and in so far as it is a branch of social science, it is a study of the problems of the material well-being of human society. Material well-being of a society is presumed to depend on the flow of consumption of material goods and services. This implies that economics deals with the consumption of goods which yield utility to consumer, but these goods are to be produced by using scare resources of the society. Such production involves, directly, conversion of some natural resources with the help of human labour and manmade capital into final consumable goods. Such material resources would be low entropy, abiotic and biotic substance which after conversion flow as high entropy waste back to nature itself. Thus, nature acts both as a source and as a sink for augmenting human consumption. It is presumed that high entropy wastes which flow back to nature are degraded and converted ultimately by nature for regenerating its low entropy resources.

In theory, ecology and economics should be companion disciplines. In practice, however, economists deal with human works and with market goods and services, while ecologists have until recently focused on the natural environment and the mostly nonmarket but nonetheless vital goods and services of nature (air purification water recycling, soil enrichment, etc.). The result of both disciplines taking an overly narrow viewpoint is that the general public tends to view ecologists and economists as adversaries with antithetical visions.

Ecology is now increasingly becoming a discipline that emphasises a holistic study of both parts and wholes. While the concept of the whole being greater than the sum of the parts is widely recognized, it tends to be overlooked by modern science and technology which emphasis the detailed study. of smaller and smaller units on the theory that specialisation is the way to deal with complex matters. In the real world, the truth is that although findings at any one level aid the study of another level, they cannot fully explain the phenomenon occurring at that level, which must also be studied to get the complete picture. Thus to understand and properly manage a forest, we must not only know about trees but also know about the unique characteristics of the forest as it functions in its entirety. It is to be noted, however, that some attributes become more complex variable as we proceed from small to large units, but in the process rates of function become less variable. For example, rate of photosynthesis of a whole forest or whole cornfield is less variable than that of an individual leaf or plant within the community, because when one leaf, individual or species slows down, another may speed up in a compensatory manner. More specifically we can say that homeostatic mechanisms, which we may define as checks and balances that dampenoscillations, operate all along the line. We are familiar with homeostatic mechanism in the individual as, for example, the regulatory mechanisms in the nervous system that keep our body temperature constant despite fluctuations in the environments. Regulatory mechanisms also operate at higher levels, as, for example, in maintaining the carbon dioxide-oxygen balance in the atmosphere.

The word Environment denotes that part of the world that surrounds us. We usually refer to the environment as if it were a resource, a platform, for human activity but not actually the place where we live. That is not surprising, since, through culture, we humans have progressively distanced ourselves from the reality and rhythms of nature. Consequently, we seem to stand outside the framework of nature, unconstrained by the underlying ecological dimensions of our existence, and free to act according to the dictates and values of our fabricated culture. Environment is increasingly becoming an anthropometric concept, primarily interested in those relationships that mainly affect the existence of man, e.g. the effects of pollutants in the air and water on human health and longevity and the measures to be taken to combat the problem. Yet, the essence of the ecological framework is an obligatory interdependence between living organisms and their physical and biological environment. It is that web of interdependence, of mutuality, that makes up the 'ecosystem'.

Before discussing 'ecosystem', it is necessary to briefly examine the distance that has opened up, between the natural environment that shaped human biological evolution and the environment in which we now predominantly live. In the physical environment of the Pleistocene savannah, over the past several million years, our *Homo* predecessors existed as small extended family groups, gathering food, hunting, maturing, raising children and attempting to avoid the daily dangers of predators and rival groups. Over the past few thousand years, our capacity to supplement our biological attributes with cultural adoption has led us reshape our living environment. This reshaping involves domestication of plants and animals, the creation of cities, the industrial, technological and informational revolutions. In terms of health these cultural developments have made for more physically secure lives, assured food supplies, and the control of some infectious diseases. But they have also tipped some ecological scales in the other direction, fostering crowed-dependent infectious, promoting the spread of infections agents through high-speed long distance travel and transport, increasing the risks of nutritional deficiencies, creating health damaging dietary excesses and causing the various environmental and psychological strains of overpopulation and urbanization. More broadly, these cultural technical developments also underlie the major incipient disruptions to global ecosystems.

The term *'ecosystem'* was coined in the 1930s by an English botanist named Arther Tansley (1871-1995). He was one of the founders of the world's first ecological society, the British Ecological Society. Though his field of specialization was vegetation, he had broad interests, including geology, psychology, and the philosophy of science and its methodology. In 1935, he coined the term for biotic and abiotic components considered as a whole. It refers to a bounded system of dynamic interdependent relationships between living organisms and their physical and biological environment. While some ecosystems have a clear and separate identity (as on small remote islands), generally there is continuity between adjoining ecosystems. In aggregate, the world's ecosystems occupy the biosphere. The concept 'biosphere' was developed early this century by a Russian scientist, Vernadekey, and refers to the domain on and near Earth's surface where the prevailing conditions enable solar energy to produce the geochemical changes necessary for life. The biosphere comprises all living things along with lower atmosphere, the hydrosphere (predominantly the oceans) and the upper lithosphere.

Ecosystems provide the framework within which incoming solar energy is captured and channeled thorough a hierarchy of life-forms. Plant life, on land and at sea, provides nature's solar panels that convert sunlight to storable, and edible, chemical energy. Animals feed on these plants and on other animals. The quest for *'food'* is thus the central organizing principle of life within energy ecosystem.These ecosystems possess mechanisms by which nutrients are retained and recycled and by which water and respirable gases are disseminated and replenished. It may be important to mention that one of humankind's greatest ecological disruptions is the accelerating loss of nutrients from land to sea, as sewage, wastewater, agricultural runoff and eroded topsoil. Life does not create new matter. Instead it recycles nutrients, using solar energy to build and maintain the temporary biological structures.

Through the simultaneous evolution of species, ecosystems acquire self – stabilizing mechanisms and dynamic internal balance. Within a stable ecosystem, one species usually does not decimate another as otherwise, the food supply of the predatory species would disappear. This is not to say that the number of species and the form of their interdependent relationships is immutable, nor that there is no competition and change. Over the millennia the global environment has changed considerably and ecosystems have changed continually as different evolutionary players have strutted and fretted their hour upon the world's stage. But, in the shorter term, ecosystems tend to maintain their internal balance at all links along the food chain.

The internal balance within ecosystems entails a web-link interplay between many species and their inanimate environment. This balance between species results either from the simultaneous evolution of mutually supportive species or from what Richard Dawkins calls the 'biological arms race' between competing species. Suppose that the biological evolution of owls and of mice proceed in parallel. Balance is maintained and both species survive. However, if, extraordinarily, a mutant strain of superfertile owls with infrared telescopic vision eyes suddenly evolved, then, during several generations of well-fed owls all the mice would be caught and eaten and owls would then go hungry. In fact, such extreme scenarios do not happen in nature, where change is slower and systems-feedback occurs. However, that sort of wholesale eradication can occur when an introduced predator or competitor disturbs an otherwise stable ecosystem. In Australia, for example, predatory foxes and feral cats along with voracious competition from rabbits and goats – i.e. four recently introduced species – are progressively wiping out the indigenous small marsupials. Indeed, in just 200 years Australia has accounted for one-third of all of the world's mammal extinctions over the past 500 years.

It is axiomatic that an ecosystem cannot yield substantial and sustained increases in materials and energy to the human species without, in the first instance, depriving other species and, eventually, causing damage to the productivity and viability of the ecosystem. The problem is not just one of overdrawing against nature's capital assets, but of disrupting the productivity and workability of nature's systems. Earlier arguments, from Malthus to Meadows ('The Limits to growth'), were based on simple models of resource limitation, predicting crisis after the intersection of the graphs of falling supply and rising demand. However, neither argument foresaw the technological innovations that have repeatedly rolled back those limits, thereby buying time. In 1987, the UN's World Commission of Environment and Development (WCED) took a longer and more ecologically oriented view of the notion of limits, arguing that the exploitation of natural resources must be constrained if it is to be indefinitely sustainable for future generations. Where Malthus had had asked about the imminent limits to the rate of food production, the WCED asked about the long-term viability of the agricultural production base i.e. the world's soil and fresh water. On this view, the critical limits apply not to the supply of materials but the planet's capacity to absorb wastes such as carbon dioxide and to replenish soil and fresh water.

Underlying much of the debate about when the graphed lines will cross, or when the limits will be met, is an assumption that we are dealing with simple systems that conform to a mechanistic Newtonian world in which relationships are obligingly linear. But ecosystems are not like that. At some point an external load will overwhelm the system's resistance and rapid change or collapse then ensues. For our early nineteenth-century predecessors, the study of natural history assumed 'creationist' orderliness and constancy. By contrast, modern twentieth-century ecology (as with aspects of the contemporary theories of 'chaos' and 'complexity') recognizes uncertainty, complexity and changeability.

Viewed within an ecological framework, it becomes plausible that overloading the biosphere will, at some point, disrupt life-support systems. However, we cannot easily foresee when we will overstep the mark, since thresholds in non-linear systems are difficult to anticipate. Today's problem of ozone depletion and incipient climate change have occurred because self-correcting mechanisms within the biosphere have become overloaded. Once such a threshold is passed the momentum of induced change continues, and feedback mechanisms that amplify or constrain the change may be activated. If regenerative powers or absorptive capacities are long exceeded, the system may collapse, causing what catastrophe theorists call a 'discontinuity'.

Non-linearity has been well illustrated by the sudden appearance and then rapid spread of forest dieback in Europe and North America after decades of air pollution with acid-forming gases and by the recent algal blooms ('red tides') along the eastern Italian coast caused by the increasing pollution of coastal waters with agricultural, industrial and domestic chemical wastes that have eventually exceeded the aquatic system's self-cleansing capacities. Because of these sorts of non-linearties we may have misestimated the impending warning effect of anthropogenic greenhouse gases. While the increase in the consumption of fossil fuels may be linear, the environment response is not.

We have already referred to homeostatic mechanisms which enable complex interrelated systems to achieve a constancy of environment and function despite the disturbances posed by external stressors. More radically, a similar phenomenon has been proposed for the whole biosphere by James Lovelock, an eminent British atmospheric scientist. According to Lovelock's Gaia hypothesis the components of the Earth's biosphere – comprising all living organisms, the geosphere and the cycles of water, gases, nutrients and energy - make up a global homeostatic mechanism that ensures constancy of the environment. Gaia (from the Greek goddess 'Mother Earth') thus acts as a coordinated, self-regulating superorganism, using feedback mechanisms to counter externally imposed disturbances.

Lovelock's formulation of the Gaia hypothesis takes shape from two fundamental questions. First, how is it that the configuration of chemical, physical and thermal circumstances of Earth's biosphere are so different from those observable on the surface of other planets? Second, how are these conditions maintained over long periods of time in the face of external perturbation? For example, over several billion years, the heat output of the Sun has increased by around 30% and yet the Earth has maintained a relatively constant temperature in contrast to the effect that an increase in external temperature would have had on an inert object. Lovelock argues that the increase in solar energy would have stimulated increased photosynthesis, which would have removed carbon dioxide from the atmosphere, thereby reducing the natural greenhouse capacity of the atmosphere and facilitating compensatory global cooling.

Other planets do not have free oxygen in their atmosphere, and neither did Earth before the appearance of photosynthesizing plants. Atmospheric oxygen and its derivative ozone shield are the product of life on earth and subsequently, they have enhanced the evolution and survival of life on Earth. According to Lovelock's Gaia hypothesis, oxygen has accumulated in the atmosphere to a level that is optimal for biological life, thus reflecting the balance of positive and negative feedbacks from dependent living organisms when the oxygen level is below or above the 'optimal' level, respectively.

The Gaia hypothesis has come in for criticism for several reasons. First, it is not possible to test the hypothesis according to the canons of conventional science. Second, the hypothesis has been taken by some to imply a purpose and altruistic farsightedness in assembled Nature. Unfortunately, this is not evident from our observations of unthinking plants and instinct – driven animals. Third, it does not seem to fit comfortably with the mechanistic view of the world. Thus the Gaia hypothesis stretches contemporary credulity. However, its heuristic qualities have stimulated awareness of the interdependencies within ecosystems and of the homeostatic mechanisms that, within limits, act to stabilize and sustain this planet's life-support systems.

Energy and Entropy

If there is one single common denominator of life on earth, that is, something that is absolutely essential, the answer would have to be energy. In physics, energy is defined as the ability or capacity to do work, with work defined in the broadest sense of "to do or perform something". While one is working at some job or hobby, or relaxing, or even sleeping, his body is performing thousands of vital functions that require energy of a specific amount or kind. The amazing variety of organisms and functions involved in keeping our life-support systems operating require a great deal of energy. The primary energy source of heterotrophs, of course, is food and of autotrophs it is light and the indirect solar energies (wind, rain) required for photosynthesis. In addition, human societies, especially industrialized ones, require large amounts of concentrated energy in the form of fuels. It is important for everyone to understand the basic principles of energy transformations, because without energy there can be no life.

It was in 1976 that Barry Canons drew attention to (1) our lack of understanding about the interlocking of these systems: ecosystem, production system and economic system – through energetics and (2) the futility of resolving a problem in any one of these systems as if it were separate from the other. But the credit eventually goes to H.T. Odum who developed most fully the concept of energy as the common denominator in ecology and the link between ecosystem and economic system.

In Economics energy is regarded as fuel which may be commercial or non-commercial and which is required as utility input in production, as fuel input in cooking, lighting etc. in respect of household activities or as fuel input for providing motive force in transport equipment. While considering energy balance of an economy, food energy is not regarded as an energy item. Despite the fact that in production activity relating to food and agriculture energy inputs are obviously required, for solar energy, food and agriculture are nonetheless regarded as non-energy sectors. While ecological process of solar energy flow is vital in the productivity of primary sector of the economy, they do not appear in the economic balance relation as ecological services like solar energy flow are not marketed. As the conventional accounting system has no room for any sector without corresponding expenditure flow, the ecology-economy interactions are not accounted for by the methods of conventional economics. Given such a narrow definition of energy, it is of no use for analyzing ecological sustainability of developmental process. In the analysis of sustainable development, the totality of energy flow of ecosystems has undoubtedly a bearing on human well-being.

A living organism has two principal functions, namely, to construct and maintain its physical structure and to run the basic life process. For the first function, it has need for nutrients and for the second, it requires energy. Without energy living organism will cease to function. In terms of availability, however, nutrients and energy are quite distinct. Nutrients circulate in the ecosystem through exchanges between its biotic and abiotic components. On the other hand, once energy is used by a given organism, it is converted into a degraded form of heat. In such a form, energy can no longer power life processes and is eventually lost to the ecosystem. This one way flow of energy follows from laws of thermodynamics of physics.

The behaviour of energy is governed by two laws, known as the laws of thermodynamics. The first law states that energy may be transformed from one form, such as light, into another, such as food, but is never created or destroyed. The second law states that no process involving an energy transformation will occur unless there is a degradation of energy of a concentrated form, such as food or petrol, into a dispersed form, such as heat. Because some energy is always dispersed into unavailable heat energy, no spontaneous transformation (light to food, for example) can be 100 percent efficient.

The second law is sometimes known as the entropy law. Entropy (from *en:* in; *trope*: transformation) is a measure of disorder in terms of unavailable energy in a closed thermodynamic system. Thus, although energy is neither created nor destroyed during transformation, some of it is degraded to an unavailable or less available form (dispersed heat, for example) when used (i.e. transformed). Energy cannot be reused, in contrast with materials such as water, nutrients, or money, which can be recycled and reused over and over again with little or no loss of utility.

In the received theory of economics there was no value attributed to the inherent property of natural resources. Value added in the process of transformation was due to two agents of production, capital and labour. Natural resources had no role in the production function formulated in economics. Exhaustibility of the natural resources could not be considered here. There would be no limit to growth as long as labour and capital continued to expand over time. In a critique of the neoclassical theory of production function Georgescue Roegen advanced an alternative form of production function bringing out explicitly the role of resources and wastes in it. Received theory argued that the problem of exhaustibility of natural resources could be met by substitution of natural resources by man-made capital. It ignored the laws of thermodynamics which stated that a part of the matter always turned into waste in the process of production. Growth of an economy could not be maintained indefinitely because of the constraints of the second law of thermodynamics. Economic process use low entropy matter and apply energy to produce matter in a state of high entropy. In the process, part of energy is dissipated in the form of heat, and a part of matter turns into waste dispersed over environment. Matter is gradually exhausted and wastes continue to degrade environment over time. Energy that is dissipated becomes unavailable for further use. Organisms and ecosystems maintain their highly organized, low-entropy (low-disorder) state by transforming energy from high to low utility states, Living systems and the whole biosphere are what Ilya Prigogine has called "far-from-equilibrium systems" that have efficient "dissipative structures" to pump out the disorder. Prigogine won the Nobel Prize for his theoretical analysis of nonequilibrium thermodynamics. He was able to explain better than any one before him how living systems seemingly defy the second law by self-organizing to maintain an open, far-from-equilibrium state. Entropy, it turns out, is not all negative; as the quantity of energy declines in successive transfers, the quality of the remainder may be greatly enhanced.

The respiration of the highly ordered biotic community is the dissipative structure of an ecosystem. By analogy, well-organised maintenance personnel and plenty of tax revenues are required to dissipate disorder and maintain quality in a city. If the quality and quantity of energy flow through a forest or a city is reduced, or if disorder dissipation is inadequate, then the forest or the city begins to degrade and senesce (becomes disorderly). This happens to a lot of cities and to forest that are unduly stressed by air pollution.

To survive and prosper, natural and man-made ecosystems alike require a continuous input of high-quality energy, storage capacity and the means to dissipate entropy. These three attributes are part of what H.T. Odum calls the maximum power principle, which states that the systems most likely to survive in this competitive world are those that efficiently transform most of the energy into useful work for themselves and surrounding systems with which they are linked for mutual benefit.

The person who introduced thermodynamics to ecology was Alfred James Lotka (1880-1949), a physical chemist by training. He developed a new field which he called *"physical biology"*. Lotka's basic thesis was that the organic and the inorganic would function as a single system with all components linked through thermodynamics in such an intimate way that it was impossible to understand the part without understanding the whole. In 1925 he published a book entitled *Elements of Physical Biology,* outlining his theories developed over a period of 20 years. His book which was to become a classic (republished in 1956 under the title Elements of Mathematical Biology), attracted the attention of ecologist Charles C. Adams. Lotka felt that biologists took too narrow a view of evolution when they focused their attention on individual species. He believed that natural selection must also operate on the energy flow of the undivided system; this concept is known as the maximum power principle. It is significant that a biologist (Tansley) and a physical scientist (Lotka) independently came up with the idea of the ecological system as a major functional unit in the biosphere. Because he colned the word "*ecosystem*" and it has caught on, Tansley gets most of the credit, which should be shared with Lotka.

Ecological Ideas in Human culture

Modern man has begun to think of the world as a biosphere and not just as a geosphere. For a better part of the past 500 years of European-led expeditions and colonization, the interest of those countries has been in discovering, mapping, acquiring and controlling the territory. The world has been viewed as real estate, to be owned and developed. This view peaked several decades ago in the ethos of the Space Race. A different view of the Earth was fostered by the remarkable image, seen from space in 1968, of a small and fragile planet suspended in a vast and disinterested black void. The world was visibly a biosphere of finite size. It is an irony that while a new ecological awareness is seeping into the rich countries as a result of the increasingly populist 'green movement', their economic values and free-market ideology are assaulting the poor and middle-income countries of the developing world, often distorting traditional cultures that have their own mature ecological wisdoms.

Lynn White, the historian, wrote a seminal essay, *The Historical Roots of our_Ecologic crisis*, in 1967. It examined the values imparted to European culture by Western Christianity (and, before it, by the Judaic ethic). These values emphasize on ownership and domination of the environment, the virtues of hard work, utilitarianism and the role of science as the means of finding out how God's Creation works and of technology as the means of applying that knowledge. Western Christianity ultimately prevailed over its more contemplative counterpart, Eastern Christianity, which construed the world as a set of symbols through which God's will was revealed. White's influential essay drew attention to the anthropocentric conceits we have inherited from the ethical and religious traditions of European culture. He showed that the exploitative, destructive and unseeing attitude towards the biosphere, which characterized the world's dominant culture, arose irresistibly from the Judeo-Christian ethic. J. Passmore in his *Man's Responsibility for Nature* (1974) argues that white has misunderstood the Old Testament (Jewish) view of nature as the work of God available for man's use but not intended for man's domination and exploitation. Much of the early writing coincided with nomadic pastoralism where humans shared the world with other living things not directly under man's control. Later, after the Greek Enlightenment, the view arose that the world exists purely and simply for man's sake. It was that intellectual tradition that Christianity has inherited and which led in the seventeenth country to the Baconian-Cartesian view that nature was there for man to transform as he pleases. White also reasoned that as Enlightenment unfolded during the eighteenth century and a mechanistic view of the universe emerged, responsibility to God lost its meaning and thus no further codified basis for responsible behaviour remained.

During the same century the radical idea of progress emerged. Previously, most societies had lamented a lost Golden Age and many had imagined the world to be inexorably declining towards a day of reckoning. In Europe, the steady advances of science and technology began to impress upon people the idea that history may be a chronicle of progress rather then of decay. Later that century, the free-market doctrine proclaimed that what was good for the individual entrepreneur must be good, in aggregate, for society. The view that nature was there for humans to transform and use entered the mainstream ideology of modern industrialized societies. This century it has been a central assumption of capitalist societies.

Several years before White's essay appeared, Rachel Carson, in *Silent Spring* (1962) argued that these same environmentally insensitive values were decimating the wildlife that is an integral part of the biosphere within which we humans have evolved. The disruption of ecosystems by profligate use of modern agricultural chemicals such as DDT would more than silence bird-song in Spring. It would undermine interspecies dependencies and would ultimately impair our food chain and water supply.

Despite the laying of a foundation of new awareness, Western intellectual traditions are at variance with thinking within an ecological framework. During the seventeenth century European philosophies such as Spinoza and Locke challenged the dominant human-centered view of the world. In nineteenth-century Britain, various scientists began expressing concerns about the impact of deforestation and agricultural mismanagement on local ecological systems in the colonies, on the wider climate and, of course on the long-term survival of mankind. In recent years there has been some greening of Western philosophy, embracing notions of the intrinsic rights of nature and the more radical ideas of *'deep ecology'* which reject the primacy of human specious. But these have been only tiny cross-currents within the predominantly materialist and utilitarian mainstream of western philosophy.

Main traditional primitive cultures, of negligible impact on today's world, have an animistic religion in which humans are part of the cosmos. According to the historian John Young, man sought to manipulate nature to his advantage, using the spiritual technology which defined his culture, but he did not think of mastering it. The Australian Aborigines have an elaborate set of personal totemic links with the spirits of other animals and of physical sites, in what is a part real part fantasy ecosystem. This spiritual bonding of tribal aboriginal groups to particular land sites has baffled mining company executives in modern Australia by its non-utilitarian, non- propertied view of land. Hinduism has a pantheon of animistic deities. The idea of active management of nature by humans forms no part of Eastern religion, be it Hinduism or Buddhism. For Buddhists, active stewardship of the Earth is not compatible with the goal of spiritual salvation through freeing oneself from all Earthly bandage.

In reality, the acute problem that we face are the various forms of environmental degradation and ecosystem disruption. Some of these degradations and disruptions proceed invisibly i.e. water table depletion, toxic waste accumulation, some slowly e.g. global warming, some remotely e.g. soil erosion, increased food shortage, projected spread of infectious disease vector, Third World urban congestion, squalor and social breakdown. Yet these environmental changes are global in scope and they endanger the health of human populations. They also challenge our social and economic value system.

Under the present economic orthodoxy, the neoclassical free-market model externalizes the cost resulting from resource depletion, population, ecological disruption and health impairment. The result of this myth is that increased economic productivity is seen as *yield*, as the creation of wealth, when in fact much of it depends on the expenditure of environment capital. The World Resources Institute has recently estimated that 4% increase in Indonesia's cereal productivity over the past decade has been almost offset by a 4% reduction in soil fertility. Yet, the UN-approved system of national accounts reports the former gain, but not the latter loss. Historically, all settled human cultures have squandered their environmental capital to some extent, e.g. fertile soils, freshwater, forests and fuels, or in other words, non-renewable resources. Even now the scenario has additional resources, if not new frontiers. The option is rapidly being closed off in today's overcrowded world. Orthodox economics has so far evolved as rationally allocating scarce resources among competing ends. Time has come for it to address itself to the less familiar prospect of finite, exhaustible resources.

Western philosophy has dealt little with ecological perspectives. Its rationalist and materialist ideas have obscured understanding of the nature and needs of economic systems. However, as we begin to understand the profound problems caused by ecological disruption, we have a gradual perception of the need for a reordering of social values.

Ecological Ideas in Economic Thought

When western Europe was undergoing intensive industrialization in the eighteenth and nineteenth centuries, economists of the time (classical economists) were concerned about sustainability of such industrialization. Their models of development forecast the approach of the industrial economy towards a stationary state in the long run. Physiocrats, primarily William Petty drew attention to the fact that land in nature along with labour creates value. Hence if there are any constraints to growth they must be either labor or land or both. By contrast, Adam Smith viewed the limitations of the market as the constraining factor. There were others, of the same classical school, who highlighted the importance of nature. Ricardo, for example, referred to the inelasticity of the supply of land which causes diminishion returns to land at the extensive margin as population and labour working on it expand. Given the inelastic supply of land, limits to the growth process are posed by the forces of diminishing returns to land. Thomas Malthus was perhaps the first to warn of the possibility of severe resource shortages (specifically, food shortages) as populations tend to increase exponentially. His predictions were primarily based on the assumptions of humans seeking to expand the population with unrestrained additions to the family size, and the lack of any contribution from technical efficiency improvements (including the role of human capital) in the food and other production systems. Fortunately, Malthus has been proved wrong during the past two centuries. Malthusian argument went to the extent of suggesting that paying more than subsistence wages for labour would lead to more children and more strain on food resources. The line of reasoning supported the idea that it may not be desirable to grant relief to the poor, and this earned for economics the name "the dismal science".

The industrial developments which started around the middle of the nineteenth century entailed resource depletion and environmental problems. The era, therefore, marked a phase in which several significant economic and environmental philosophers came to the fore. Some economic concerns were expressed by noted economists including John Stuart Mill, Karl Marx and Alfred Marshall. The significance of natural resource limitations and their depletion was noted by each one of these scholars, although their perspectives differ. Mill advocated the concept of Homo economicus which assumes the behaviour of humans as rational self-interested wealth maximisers. Marx viewed the problem of unsustainable development as a result of the class structure of the society. The sustainability of food supplies and the loss of soil fertility and land holdings were viewed as the limiting constraints on the food supplies. Marx pointed out that the capitalist mode of production would not allow sustained soil fertility. Marshall, on the other hard, believed that people tend to pay attention to sustained land and soil productivity. The relative scarcity of quality air and other environmental public goods was noted when Marshall argued that, for the sake of a little material wealth, we may be wasting some of the factors of production.

John Von Neumann, the well-known co-founder of game theory, was concerned with large-scale human interventions. He made two observations:

1. The result of human interventions, like the emission of carbon dioxide, adversely affects the natural environment .
2. The result will be to "merge each nation's affairs with those of every other, more thoroughly than the threat of nuclear war or any other war may already have done".

This is precisely what we see at the end or the twentieth century.

It is rather ironic that, for most of North American history, the most important resource management problem was how to exploit mineral and other natural resources as quickly as possible. The interdependencies of the planet Earth's resources and their finiteness were seen by many thinkers. Nations and empires rise and fall on the tides of

> climate change, argued R.H. Wheeler in 1946. Soon after World War II, Aldo Leopold was an early proponent of the ecosystem approach, emphasizing the links between people and the ecological systems.
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> One of the earliest and most significant methodological contributions is due to Harold Hotelling (1931) in the context of economics of exhaustible mineral resource extraction. The Hotelling rule went almost unnoticed for a few decades and became a widely debated method only since the 1970s. The Hotelling rule for optimal resource extraction states that, in a certainty governed world, an additional unit of resource will be conserved only if the resource price (net of costs) rises at a rate faster than the market rate of interest.

A.C. Pigou dealt with the problem of externality giving rise to market failure. Market allocation under externalities diverges from that under perfect competition, creating welfare losses to society. Welfare losses are associated with both harmful and beneficial externalities. In the absence of any outside control investments that impose harmful or negative externalities will be excessive since investors will not account for external costs in equating marginal private cost and marginal private benefit. Industrial pollution is the classic example, industrialists invest on the basis of private costs and returns, neglecting to account for social costs resulting from pollution. Activities with beneficial or positive externalities, on the other hand, suffer from under investment because the full magnitude of benefits is not accounted for by the private investor. A good example is the watershed benefits provided by soil and water conservation and afforestation in the upper catchments of a reservoir. These activities augment groundwater stocks in the lower catchments and reduce siltation of the reservoir.

Externalities result from incomplete property rights. Given the limitations of the property rights approach to internalizing externalities, Pigou suggested the use of taxes and subsidies to encourage economic agents to internalize externalities.

The discussion in the environmental economics focuses basically on optimum level pollution or degradation. The analysis crucially depends upon the valuation of environmental service or damage. Unfortunately, the methods of valuation currently used reflects very imperfectly the impact of economic processes or ecosystems. Apart from the question of valuation, there are also issues of an institutional nature. An important issue, for example, is whether the problems of environmental sustainability of the development process can at all be resolved within the market institutional framework. Co-operation and participatory management as observed in the commons institution have emerged as an important option.

Sustainability and Sustainable Development

There is broad agreement today that sustainable development is essentially an interdisciplinary concept. Its origin does not wholly owe to principles of economic theory, despite the fact that the important issue of intergenerational equity was addressed by Robert Solow. Economic theory itself recognized the critical role of environment and ecology in the managing of economic systems. It is hard to ascertain if there is any unanimity in the theory and application even after decades of intense debates on these issues.

It was Aristotle who asserted long ago that human well-being is realized only partly by satisfying whatever people's preferences happen to be at a particular time, it is also necessary for successive generations to leave behind sufficient resources so that future generations are not constrained in their preferences. Less technically speaking, the future set of meaningful choices should be at best as good as the set available to the current generation. Since choices include those of economic and non-economic factors, this version is not amenable entirely to economic interpretation above. The debate on sustainability and sustainable development, often without a clear distinction between the two, continues to engage attention at various levels of society. Most alternative objectives and means of achieving these originate either explicitly or implicitly in the fundamental approaches of ecocentrism and anthropocentrism. Ecocentrism is an environmental philosophy which views human activities in terms of their implication for ecological ingredients.Underlying anthropocentrism is the idea that all human activities must be in the primary interests of the humans for achieving the desired objectives and goals of the society, whether or not some of the features of the environment and ecology are kept in tact or disturbed. Even then every analysis need not be viewed in terms of the dichotomy of the approaches. After all, a totally anthropocentric approach will, sooner or later, reach a critical stage when the ecological and biogeophysical limitations in the functioning of the systems form impediments to the continuity of human survival and stability itself. There is undoubtedly some scope to accommodate a reasonable balance of both the anthropocentric and ecocentive approaches.

It is imperative to take into consideration biological, ecological and economic perspectives on the integrally related themes of sustainability and sustained development. The economic approaches alone are not comprehensive in the absence of an appreciation of the behaviour of the ecosystem and biogeophysical systems. It is for this reason that important structural phenomena like nonlinearties, resilience and irreversibilities should be carefully considered. The loss of system resilience forms the most significant aspect of unsustainability with considerable potential for catastrophies and irreversibilities. Any definition of sustainability or sustainable development must recognize this feature.

Most phenomena on earth exhibit nonlinear behaviour, whether it is the growth in the size of the population, or compound interest accumulation on a principal amount of capital. Ecological change is neither gradual nor continuous and is very often subject to nonlinear behaviour. The behavioral relationship in a wide variety of animals is, for example, nonlinear. Biologists generally refer to the nonlinear relationship between the intake of toxic inputs and the physical fitness of an organism. It is also observed that when environments fluctuate, the mean fitness of a genotype is usually represented by its geometric mean fitness rather than arithmetic mean fitness. The nonlinearity in ecosystems leads to unpredictable behaviour because

(1)Random small changes can propagate disturbances dramatically and push the system to another path of its evolution (as in 'chaos theory; a theory which is a mathematical study of complex systems whose behaviour is highly sensitive to slight changes in conditions, so that small alterations can give rise to strikingly great consequences).

(2)Stable relationships collapse as slow processes accumulate and move the system from one set of controlling mechanisms and processes to another (as in catastrophe theory).

Nonlinearties give rise to discontinuities. In the areas of medical science, an example arises in the phenomenon of heart attacks: discontinuities or nonlinear functions between time units and the quantity of blood pumped into the heart. Similarly, the increase of fossil fuel consumption can be somewhat linear but the atmospheric pollutions response often is not. Thus, the pollution-absorbing capacity of the atmosphere possesses properties of nonlinearity as well as significant irreversibility. Another example of nonlinearity is environmental cost that rises disproportionately with incremental or cumulative changes in global climate.

Another concept closely related to nonlinearity is that of resilience. It is the ability of a system to absorb disturbances. This may be interpreted as the ability of systems or species and organisms to respond to various disturbances to their environment and to restore status quo ante features. Usually, resilience is lost when the range of tolerance for variations in the environmental factors are crossed by the disturbances or external influences. It is to be noted that the tolerance level of a system for any environmental or ecological stress tends to be reduced when there are other stresses. This enhances the vulnerability of the system to multiple disturbances and the linkages obey nonlinear relationships. Loss of resilience tends to shift a system towards its thresholds and eventually leads to its flip from one equilibrium state to another. The Great Lakes in the USA are considered an example of an ecosystem which suffered loss of resilience and led to an irreversible loss of some of the biological stocks of species. Some of the biogeophysical systems may not possess the same level of adaptability to changes as do some other subsystems of the ecological systems. Thus the former are likely to suffer irreversible consequences when their resilience features are lost. This is seen in almost all the groundwater systems when water withdrawal exceeded their critical limits without appropriate attention to the recharging of the water table. When the limit was exceeded, the system went dry never to return back to the original configuration. Some historical civilizations underwent these experiences. Most civilizations flourished as "water civilizations" including those which began in Egypt along the Nile River and in South Asia along the Indus River System. These were known to have thrived before and around 5000 BC. Parts of these regions were later abandoned when over a period of time, the territory become a desert. The Mayan Civilisation in the Western hemisphere began to flourish around the third and the fourth centuries AD. The civilization collapsed rather suddenly during the tenth century, a period which coincided with temperature rise and climate change in the region.

A third concept relating to nonlinearties is irreversibility. Some examples of this are bioaccumulation of toxins, desertification and loss of biodiversity. All of these highlight the need of safe margins of protection of the environmental assets. This is required even before relevant information can be obtained. If the occurrence of the disaster is the only way to generate information, it may be either too late or too expensive for any corrective restoration. This is an illustration of the well-known Arrow's paradox of information: the value of information may not be known until we obtained the information but one may not be willing to pay for such information since the value is not known a prior.

The biological extinction of any species is one of the several examples of irreversibility of environmental damage, so are some of the concentrations of the greenhouse gases (GHGs) possessing very long life spans. Even if these GHGs are technically reversible over a period of time, the irreversible damage to the system would have resulted much before the concentration of these GHGs is diffused.

Any major disturbance to the ecosystem has direct and near future adverse implications for the life-support systems sustaining the economy. This is particularly valid when the limits of the carrying capacity are being approached or already reached. The trade-off between foregoing one or the other beyond certain critical ranges, like appropriately defined carrying capacities, seems an inevitable pre-requisite for the sustained survival of all forms of life. One of the definitions of carrying capacity states that it is "the maximal sustainable load that human kind can impose on the environment before it loses its capacity to support human activity." (The Independent Commission on Population and Quality of Life, 1996). It is evident that when carrying capacity is exceeded, there could be irreversible consequences. Some of the potential benefits and losses of ecological disturbances and consequences of the unsustainable paths of development can be viewed from these perspectives. Biologists apply the concept of carrying capacity to examine the maximum limit on the population size of any species or a combination of different species which can be sustained by a habitat indefinitely. At the planet level for all earthlings, the limit is expressed in terms of "net primary product" (NPP). This is defined as the total amount of solar energy converted into biochemical energy through plant photosynthesis, called gross primary production (GPP), minus the energy those plants use for their own life processes, also called energy expenditure of respiration, R. In other words,

$$NPP = GPP - R$$

The NPP is the main determinant of food for all life on Earth.

The problems of examining system features at varying levels of aggregation could possibly conceal the realities of the system malfunctions. For example, when one tries to estimate a relationship between the total area under forests and the extinction of biological species. This is because the fragmented forest with "edges" allows for certain ecological disturbances whereas the unfragmented forest would not behave the same way. Similarly, in seeking to maintain desired characteristics only at the average levels, one may be missing the underlying and emerging problems. In the case of large irrigation or multipurpose river-valley projects, what are usually noted are the emerging problems and their institutional management aspects while the lesson to be derived is the need for local actions, first to identify the problems, then to examine the solutions and then to adopt measures to overcome the problems. Another example is that of biogeophysical complexity compounded by excessive exploitation of the system resources, leading to a possible stress and unsustainability. This is the case of intensive agricultural development. Intensive pressures of population and scarcity of land for farming are the obvious contributory factors, but the farm input management issues seem to have taken little note of the need to preserve soil fertility on a sustainable basis.

A number of alterative formulations of sustainability were attempted in literature, from different disciplinary perspectives. The ultimate binding constraints, however, tend to remain closer to the laws of nature, since they arise basically from biogeophysical and ecological considerations. It should be mentioned that not all the layers are understood yet. If human actions are mainly responsible for jeopardizing physical survival or sustainability, these actions deserve significant attention to avert potential problems or crises. Hence, what is required is reasonable pragmatism to arrive at operationally meaningful approaches to the perceived problems and their solutions.

One of the criteria suggested is SMS i.e. Safe Minimum Standard of conservation. It is a criterion which embodies an element of sustainability in physical terms. This criterion is similar to the criterion of "minmax". The latter requires the seeking of decisions or policy choices which tend to minimize the maximum imaginable damage, a principle similar to the Rawlsian justice. As a result of this attitude in decision making, the approach entails costs of strong risk aversion, namely foregoing certain opportunities deriving current benefits so as to ensure flexibility in the set of decision alternatives for the future. On the other hand, the implications of relaxing these stringencies could be such as to incur the loss of some biological species. This results in the loss of benefits (directly or indirectly) which could be extremely significant. Besides, some of the biological consequences are irreversible.

Much of the concern in the debate on the biogeophysical and ecological dimensions of sustainable development is simply confined to the sustainability of the planet Earth's resources, with no weightage for the requisite development that concerns humanity. It is not unusual for those concerned with issues of sustainability alone to presume that once sustainability is assured, the issue of sustainable development could be handled as a corollary. This becomes an infeasible proposition, without ecosystem sustainability, but this may never be achieved if we do not accord appropriate priorities for resource exploitation and the mitigation of corresponding and other problems, with proper phasing of the activities over time and space. An appreciation of sustainability in the development sense provides a useful background for the relevant policies and programmes. This may be accomplished, in principle, with calculated cost (or risk) to other biological, physical and terrestrial entities. The complex basis of socioeconomic development in terms of the availability of life-supporting features on the planet is typically the concern of what is becoming a significant addition to the knowledge in the interdisciplinary approach of ecological economics. An effective integration of ecology and economics could be of greater help in the future.

It is easier to indicate features of unsustainability than to define sustainability. In fact, the origins of the debate stem from the observations of disturbing trends of possible unsustainability of life on this planet, with humanity playing a major role against nature. Based on the present knowledge, some of the symptoms of unsustainability may be depicted as follows:

a)Greenhouse effect and climate change
b)Atmospheric acidification
c)Ozone depletion
d)Toxic pollution

e)Biological species extinction
f)Deforestation
g)Land degradation and desertification
h)Depletion of non-renewable resources like fossil fuels and minerals and
i)Urban air pollution and solid wastes

Given these symptoms of unsustainability, it may appear that sustainability may be defined as a process under which there features are brought to tolerable levels. That, however, would be unwise as not only these features but a number of underlying fundamentals of survival need to be addressed systematically for the purpose of sustainability. A number of definitions, of sustainability from the viewpoint of biogeophysical and ecology, have been attempted which may be looked into for the clarity of the concept.

According to P. Vellinga etal (The Environment – Towards a Sustainable Future, 1995):

The concept of sustainable development can be defined as maintenance and sustainable utilization of the functions (goods and services) provided by natural ecosystems and biospheric processes. Conversely in a situation of unsustainability, where the limits of the biosphere's carrying capacity are exceeded, not all of the environmental functions can be fully fulfilled anymore.

There does hardly exist any consensus on the carrying capacity limits and fulfillment of various functions at "full" levels. The definition of carrying capacity given earlier requires a reasonable consensus on the meaning of the maximal load that supports a pre-defined level of human activity. What is really of operational significance is to discern the biogeophysical and ecological stresses.

Some of the concepts and definitions of sustainable development, which integrate ecological and economic regimentations may be considered in this context. The concepts suggest that sustainable development is:

a)to maximize the biological system goals (genetic diversity, resilience, biological productivity), economic system goals (meeting basic minimum needs, equity etc.), and social system goals (social justice, people's participation etc.) simultaneously.

b)Improving the quality of human life while living within the carrying capacity of supporting ecosystems.

A broadly accepted ecological economics definition states that sustainability is a relationship between dynamic economic systems and larger dynamic, but normally slower-changing ecological systems, in which:

a)human life can continue indefinitely;
b)human individuals can flourish; and
c)human cultures can develop, but in which effects of human activities remain within bounds, so as not to destroy the diversity, complexity, and

functioning of the ecological life-support system.

This definition comes close to a reasonable definition of sustainable development, and not simply of sustainability.

In the Rio Declaration of the Earth Summit of 1992, we find the essence of an economic approach detailed in terms of broad policy measures. These included eight "Economic Principles", including the following three:

1. The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations (Principle 3).
2. All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement of sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world (Principle 5).
3. To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies (Principle 8).

All these principles emphasize economic development in addition to sustainability. The concept of sustainability admits varying notions and definitions. Development is, par excellence, economic progress. The resulting concept of sustainable development is thus fraught with a multitude of potentially conflicting requirements. The concept of sustainability hidden deep in the principles outlined could lead simply to some kind of Safe Minimum Standard (SMS) in resource use, including preservation of environmental quality and its assets. We consider another broad definition which attempts to arrive at an improved level of precision and objectivity.

The Bruntland Report (World Commission of Environment and Development, WCED, 1987) addressed to much of the present concern for sustainable development:

> Sustainable development is development that meets the needs of the present without compromising the ability of the future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

This approach does address the issue of intergenerational resource distribution, with expressed concern for the poor. Most reports on the theme quote the first sentence. Those writings, therefore, are less than fair to the spirit of the original contributions. It is rather surprising that the poverty issue is not seriously considered in the literature, despite the fact that poverty adversely affects quality of environment and quality of life, present as well as future. No doubt, the needs of the future generations have to be understood based on the information available at the time. Assumptions about future preferences and tastes of future generations remain crucial in this understanding.

Many economists transformed the above concept and suggested that nondeclining per capita consumption measure would be a suitable indicator of sustainability. This was not suggested as an indicator of sustainable development, however. It is doubtful if the concern of the second parts of the Brundtland Report's definition above is properly recognized. Among the notable exceptions is an assertion of Solow, quoted in UNDP's Human Development Report (1996): the case for reducing contemporary inequality is as strong as for worrying about the uncertain status of future generations. The neglect of this vital issue poses a potential inconsistency in the operational approaches. In fact, as Solow argued (UNDP, 1996): "those who are so urgent about not inflicting poverty on the future have to explain why they do not attach even higher priority to reducing poverty today." It is rather naive to believe that sustainable development can be reviewed as a meaningful approach independent of income distribution policies. Ownership of resources and the process of accumulation of resources under varying ownership regimes, or more generally property rights and legal entitlement regimes are critical in this phenomenon. These play an important role in the consumption and production decisions with direct implications for sustainable development. Since any redirection of existing resource and income distribution patterns cannot be achieved within a reasonable time frame and without enormous socioeconomic costs, a softer approach is usually taken to devise what may be considered pragmatic. This takes note of the existing legal entitlements and property rights regimes. Fiscal and monetary policies constitute examples of potentially flexible, income redistribution favouring an environment-enhancing policy package within this context. Most economic democracies in the world tend to fit into this configuration.

Issues concerning resource control and management need to be related to the principles of ethical fairness and economic justice. It is to be noted that a just society cannot be indifferent to the background conditions against which markets function. Moreover, existing distributions and preferences need not be

> The weak sustainability approaches raise a number of serious objections from environmentalists and ecologists. Implicit in the assumption of a high degree of substitution is treatment of manufactured capital and ecological capital as close substitutes. In answer, it is suggested that items of ecological resources can be aggregated into the sum total valuation of biological resources and allowed to be substituted by items of person-made capital. This interpretation may not be entirely valid as there may be certain forms of life or other resource that are irreplaceable and should not be compromised in any aggregation of resources. However, if an aggregation could be allowed, the approach would be an intermediary compromise between the two forms of sustainability. This is sometimes called the "sensible sustainability" approach.

The well-known concept of sustainability advanced by Robert Solow (1994) stand close to the sustainable development approach when it states that a society that invests aggregate resource rents in reproducible capital is preserving its capacity to sustain a constant level of consumption. Solow argued that a concept of sustainability implies a bias towards investment with a general interpretation: just enough investment to maintain the broad stock of capital intact. It does not mean maintaining the stock of every single item intact. Substitution of resources is essential for continued economic progress. This statement does imply the need for continued technical progress, and continued improvements in the resource-use efficiencies. It is to be noted that Solow's insight comes very close to some of the philosophical observations of Rawls (1973), who argued that if savings processes continue for each successive generation, there will eventually be a point beyond which the rate of saving may stagnate and "it is sufficient that improvements in productive techniques be introduced only to the extent covered by depreciation." Solow's approach is very pragmatic, but is largely confined to generalized economic capacity to enable capital reproducibility and maintaining constancy of consumption. The role of the physical carrying capacity or of the environmental protection is reflected only through the effects on the economic potential and its realization in different intervals of time. The pragmatism of the approach arises when pre-specified unique features of the nature and environmental amenities are sought to be preserved without any reference to aggregate resource valuation approach. Such an approach was a part of Solow's approach, something unique and irreplaceable should be preserved for its own sake, but most natural resources are desirable for what they do and not for what they are.

Economic Institutions and Environment Management

After having made an attempt at arriving at a somewhat reasonable concept of sustainable development, what remains to be urgently considered is what are the economic institutions relevant or suitable for management of environmental resources so that sustainable development does not exist in theory alone but also made a reality. The first institution that comes to mind is the market which is generally considered as the organizing mechanism of diverse economic activities. It will be argued that there are other alternative institutions which may do the same function and therefore it is necessary to make a comparative estimate of the efficacy of the various institutions in the field of environment management.

Markets

It appears that markets are not an adequate set of institutions for our dealings with nature. Adam Smith's invisible hand is ineffective in contending with some of the major problems of resource and environmental management. The reason is that for many natural resources markets do not simply exist. For existence of markets the need for low costs of negotiation and monitoring is very great. For economic activities affected by ecological interactions involving long distances, such a requirement is hardly fulfilled. There are also interactions characterized by large intertemparal distances e.g. the effect of ozone holes on climate in the distant future. For market to exist it is also essential that private property rights is easily definable. This is not possible in such cases as the atmosphere, aquifers and the open seas because of the migratory nature of the resources. Moreover the common property character of many of the resources such as common pasture land, forest and water bodies generates externalities which, as is well known, gives rise to market failure. Externalities may be unidirectional or reciprocal. Damage inflicted by upstream deforestation on downstream farmers without compensation is an example of the former. Unregulated fishing in the open sea and excessive withdrawal from groundwater reserves, usually expressed as 'tragedy of the commons', are examples of the latter. The neoclassical method of dealing with the problem, say imposition of a Pigovian tax has been found to be wanting since ecological processes are stochastic and individuals and state agencies do not have the same information about technology (e.g. about the cost of pollution control).

Intergenerational externalities have a different structure. The arrow of time makes them unidirectional. Despite our having genuine concern for well-being of our children and grandchildren, because of institutional failure in other spheres of economic activity (purchasing, borrowing, lending insurance) our implicit concern for generations etc. in the distant future may be inadequate. This is implicit in the fact that market rates of interest do not reflect social discount rates. So, market failure involves not only misallocation of resources in the present, but also misallocation across time.

There is another reason why market cannot be expected to function well for environmental resources. One point which is frequently high lighted in modern economics is that markets are able to function well only if the processes governing the transformation of goods and services into further goods and services are linear. But because of existence of such phenomena as ecosystem stress or ecological thresholds, it is implied that the states of affairs in systems are governed by nonlinear processes. Markets cannot be expected to function well in such environments. For example, market prices may be unable to signal the impending collapse of a local resource base. It is to be noted that in such cases markets need to be supplemented in such ways as to ensure there are additional public signals to accompany prices.

Another approach to solve the problem of misallocation of resources is the defining of property rights on resources. This one is also subject to some limitations. Property rights to a resource are the rights, restrictions and privileges with regard to its use. Management of a resource base is a different matter. Property rights may be well defined, the resource may however be badly managed. This possibility is there because of disagreements among those holding the rights on how it is to be used, corrupt practices regarding its use, a lack of understanding of ecosystem functions and so forth. Ownership is yet another matter. Someone owns a resource by law, but transfers its right of use to another person for a stipulated period. Ownership does not change, but the right of use does.

The State

In the matter of environment management, the role of the state has been depicted in a major part of the current literature as that of a villain. The take-over of communal property has undermined the concerned people's urge to protect the resource base. Kerala provides a typical example of what an aftermath of state intervention in local people's affairs can do to common-property management systems with dire consequences. Paddy cultivation was the main crop. Cattle supplied the motive power for ploughing and manure for cultivated land. At the end of the nineteenth century cattle grazed freely in the forests, fodder grass was taken from the forest and tank beds were used for summer grazing before cultivation commenced. In addition, the forests also supplied firewood, leaf manure, wood for agricultural implements and medicinal plants. Green manure and tank silt, obtained from tanks, were used as fertilisers. Until the construction of the Kodayar Dam in 1907, the village managed irrigation through communally organized irrigation systems. With regard to drylands, tenants were allowed in the off-season to graze their cattle and to remove green manure. With the general increase in the area of reserved forests and by the conversion of drylands into wetlands with the Kodayar Dam, there was a corresponding reduction of peasants' rights. With the growth of the area under irrigation, the tank beds were no longer capable of supplying the inputs they had with the reduction of the area under tank beds and restrictions on inputs from the forests, inputs formerly available from forests and tank beds were insufficient and had to be purchased. Further, the state started selling the tank beds to individuals. Privatization meant that the available grazing on tank beds was reduced. Again, the Forest Department introduced the levy of fees for grazing and payment for timber (which was used for agricultural implements). The poorer peasants were therefore compelled to sell some of their cattle essential to ploughing. These sales affected the availability of manure. When the price of paddy declined in the 1930s but the price of inputs did not show a corresponding decline, many peasants were compelled to sell their lands. Over a period of ninety years, State interventions through the introduction of irrigation, the conversion of drylands to wetlands, the increase in the area of the reserved forests and the imposition of fees for forest grazing and timber had assisted in the dissolution of common-property management systems. Recently environmental degradation has been traced to government tax policy. In Brazil the exemption from taxation of virtually all agricultural income, along with the fact that logging is regarded as proof of land occupancy, has provided incentives to the rich to acquire forests and then to deforest the land. It has also been shown that accelerated deforestation in the Brazilian Amazon, followed by violent conflicts between landowners and squatters, has also occurred because of legal inconsistencies between the civil law, which supports the title held by the landowners, and the constitutional law, which supports the rights of squatters.

It has, nevertheless, to be admitted that the state must play a very crucial role in managing the environment. If markets are to work well, property rights must be clearly defined and contracts have to be enforced. This only the State can do. If the rights to the benefits of investment in a resource base of those who invest in it are to be protected and promoted, the state is the agency to which they must turn. Environmental economics emphasises on optimal instruments for pollution control. In such a matter, the State has a key role to play. Regarding public property the State has to act as a trustee on behalf of all generations. Heritage buildings, for example, are public goods which the state as trustee has the responsibility to preserve.

Community

There are certain resources which are very often neither private nor state property, but common property. Probably this was the reason why Arrow intended that the corresponding institution which can act as a means of achieving the benefits of collective action is neither the market system nor the State. In between there are what are known as community organizations managing resources and resolving conflicts and disputes. This places decision-making in the hands of people who have information and the motivation that outsiders lack and yet can avoid some of the pitfalls of privatization. There are several documented examples of successful and autonomous local community-level cooperation in the management of common property resources in different parts of the world today. There are, of course, numerous cases of failures of such cooperation as well, making it important to understand the conditions for and against sustainability of local cooperation on the commons.

While sociologists and anthropologists look at the social norms and codes of conduct in understanding co-operative behaviour, economists usually emphasise incentives and penalties. In the literature on repeated prisoners' Dilemma games, it is shown that co-operative equlibria can be spontaneously sustained by the long-run interests of foresighted self-interested individuals. The possibility of co-operation depends of course, on the future payoffs not being discounted too heavily, and/or the short-run records to defection (like stealing water from a common irrigation system) not being too large. The latter of course, will depend on the sanctions that other people can impose on the potential defector.

While game-theoretic models in general give us important insights into the sustainability of cooperation among self-interested agents in the management of common resources, it is at the same time useful to recognize that there are aspects of real-world cooperation with which the models are much too rigid and limited to be able to cope with any degree of subtlety. For example, they cannot usually handle the impact of ongoing interactions among agents in the updating and contingent modifications of the rules of the game. The latter may include group dynamics in some real-world settings of community leadership, which through deliberation and persuasion may bring about endogenous preference changes and reorientation of values in a community and thus break pre-existing deadlocks.

Both theoretical models and field studies, however, agree on the importance of group size for cooperation. Cooperation in general works better in small groups with similar resource needs and close interactions, shared norms (which act as focal points and coordinate expectations), and patterns of reciprocity. In such communities monitoring is easier, incentive dilution is less of a problem and chances of pre-play communication and learning about one another's intended plans of action are better and social sanctions are easier to implement. Migration and mobility possibilities work against cooperation. Contact with outsiders and the exit option reduce the effectiveness of social norms and prolonged repetition of the game also becomes more uncertain, raising incentives for short-run opportunism.

Local commons are in no society open for use to all. They are open only to those having historical rights, through kinship ties, community membership etc. Those having historical rights-of-use tend to be protective of these resources. Local commons are easy enough to monitor and so their use is often regulated in great detail by the community, either through the practice and enforcement of norms, or through deliberate allocation of use.

In a study on forty-one South Indian villages, it was found that downstream villages had on elaborate set of rules, enforced by fines, for regulating the use of water from irrigation canals. Most villages had similar arrangements for the use of grazing. A study on the Kuna tribes of Panama has described the intricate set of social sanctions that are imposed upon those who violate norms of behaviour designed to protect their source of fresh water. Even the caste system of India has been found to provide an institutional means of checks and balances by which communal environmental resources have been protected.

It is important to warn that all is not well with local common-property resource management. There are examples of how access to the local commons is often restricted to the privileged (e.g. caste Hindus). Rampant inequities exist in rural community practices. One can only lay stress on the fact that the local commons are not unmanaged, one cannot claim that they are invariably managed in an equitable way.

The extent of common-property resources as a proportion of total assets in a community varies greatly across ecological zones. In India they appear to be most prominent in arid regions, mountain regions and unirrigated areas. They are best prominent in humid regions and the river valleys. An almost immediate empirical corollary of this is that income inequalities are less where common-property resources are more prominent. However, aggregate income is a different matter altogether, and it is the arid and mountain regions and unirrigated areas which are the poorest.

In an important study, Jodha (1986) used data from eighty villages in twenty-one districts from seven States in India to estimate that among poor families the proportion of income based directly on common-property resources is mostly in the range 15-25 per cent. This is a non-trivial proportion. Moreover, these resources are complementary to the sources of income from private property, which are in the main labour, milch and draft animals, cultivation land and crops, common agricultural tools, fodder-cutting and rope-making machines and seeds. Common-property resources also provide the rural poor with partial protection in times of unusual economic stress. For landless people they may be the only non-human asset at their disposal. A number of such resources such as fuelwood and water for home use medicinal hubs etc. are the responsibility of women and children.

There is, however, no reason to suppose that local commons are invariably managed communally. Nevertheless, in many cases they are or have been in the past. Communal management of local resources has a link with social capital which is a name for interpersonal networks peer group effects, role models, connections in the job market etc. which act as a basis upon which cooperation has traditionally been built. Case studies have shown that communal property rights and management have prevented rural and coastal communities from experiencing the tragedy of the commons. In a study on South Indian villages it has been shown that milk producers' cooperatives are more prevalent in the drier districts. But the local commons are also more prevalent in drier districts. One way to explain this finding is that cooperation in one sphere of life (managing commons) makes cooperation in other spheres (making milk) that much easier. Cooperation begets cooperation. It may be concluded from these examples that institutions that are neither part of the market system, nor of the State, nor of the household, develop organically to deal with resource allocation problems.

There are, however, limitations of communal management of common resources. A general finding from studies on such management is that entitlement to products of the commons, is and was, frequently based on private holdings; richer households enjoy a greater proportion of the benefits from the commons. It has also been noted that the local commons have degraded in recent years in many parts of the poor world. The reason suggested is that the poor degrade their local resource base as income today, to them, is of the utmost urgency; in other words, poverty leads poor people to discount future incomes at unusually high rates relatively to today's income. This proposition, however, is difficult to interpret as there are not many empirical studies testifying to it. If discount rates were extremely high, the local commons would have been depleted at a faster role.

References

1.Bardhan, P.(ed.) (1989), The Economic Theory of Agrarian Institutions, Clarendon Press, Oxford.
2.Bardhan, P and Christopher Udry (1999), Development Microeconomics, Oxford University Press.
3.Bhattacharya, Rabindra N.(ed.) (2001): Environmental Economics, An Indian Perspective, Oxford University Press.
4.Bose, Deb Kumar (2004) Essays on Environmental Economics, K. P. Bagchi and Company, Kolkata.
5.Dasgupta, Partha and Karl- Goran Maler (eds) (1997),
6.Mc Michael, A.J. (1993), Planetary Overload, Cambridge University Press.
7.Mookherjee, Dilip and Debraj Roy (2001), (eds), Readings in the Theory of Economic Development, B. Blackwell, Oxford University Press.
8.Sengupta, Ramaprasad (2001), Ecology and Economics, An Approach to Sustainable Development, Oxford University Press.
9.Dasgupta, Partha (2001), Human Well-being and the Natural Environment, Oxford University Press.

Environmental Law – At a glance

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At the very outset the term 'pollution' has to be defined in a manner in which one can understand. One environmental scientist has provided a useful definition of 'pollution' as follows:

> "... ...the introduction by man into the environment of substances or energy liable to cause hazards to human health, harm to living resources and ecological systems, damage to structures or amenity, or interference with legitimate use of the environment."

Accordingly, the most important factor is that it is the pollution which causes harm to human health and living resources. The concept of 'harm' and 'damage' plays the central role for defining pollution. Prior to formal introduction of environmental laws, the general law provided certain safeguards. General law provided punishment for causing nuisance and/or to remove the nuisance. Now in our country even the Constitution of India has introduced Article 48A for protection and improvement of environment and for safeguarding forests and wild life. This was introduced in the year 1977 and in Article 51A(g) of the Constitution it has been made a

Fundamental Duty of the citizens to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures. The Supreme Court of India in a number of cases have held that right of citizens to live in an environment free from pollution is a right guaranteed under Article 21 of the Constitution which provides that no person shall be deprived of his life or personal liberty except in accordance with the procedure established by . law. In other words, right to life includes right to live in an environment which has a bare necessity of life and life cannot exist in an atmosphere which is charged with pollution. The Supreme Court of India who took a leading role in the matter held in many cases that right to healthy environment is a part of right to life under Article 21 of the Constitution. In Today's Emerging Jurisprudence, environmental right which encompasses a group of collective rights is described as Third Generation Human Right. Over the last 15 years the Supreme Court had to repeatedly issue directions and orders to Central Government and the State Government authorities in matters relating to the pollution control and public health. In other leading countries of the world, such as U.S. and U.K. the governmental machineries are very much vigilant for enforcing the law without leaving any scope to interfere with. No one can imagine that the House of Lords in U.K. issued directions for controlling pollution in the river Thames or the U.S. Supreme Court issued directions as to how the slaughter houses could be allowed to run. But in India the Supreme Court had to come down heavily for controlling water pollution in river Ganga and the Ganga Action Plan which is a judiciary sponsored by the Supreme Court of India. As the administrative authorities failed and neglected to perform their statutory duties or public duty the Courts of India through Public Interest Litigation and by means of judicial activism tried and still try to control pollution in a large number of cases. There was no law controlling the noise pollution before. It was the Calcutta High Court which passed a judgment on 1st. *April,* 1996 for controlling the voice of microphone and to see that the loudspeaker does not become louder. Thereafter the Calcutta High Court banned the noisy fireworks. All these judgments have created a public awareness about the ill-effect of noise pollution and it has now been established by the scientists in the last World Meet on noise pollution in Bonn that noise pollution is a source of many diseases.

It is one thing to make a law. But is a quite different thing to enforce the provisions of law strictly and vigorously. Now the statutory rules have been enacted for controlling the noise pollution and the law as made in the same line as laid down by the Calcutta High Court in Om Birangana case, but in spite of the judgment passed by the Calcutta High Court on 1st. Apri1, 1986 and in spite of making law on *14th*. February, 2000 by the Central Government in which use of any horn, displaying microphone and making any sort of noise in and around schools, colleges, universities, hospitals, nursing homes, religious places have been kept under Si1ence Zone and restricted. But the Silence Zone is not silent because of failure on the part of the administration to enforce the law for controlling noise pollution. True, noise pollution could not be controlled simply by laws and for that purpose it is essential to create awareness amongst the people about the effects and ill-effects of noise pollution and also for that purpose the prime necessity is to create environmental literacy. The present law on environment in India is wholly inadequate to meet the growing need to control and regulate pollution.

Environmental Literacy

Ecology, environmental science, and environmental studies

Prior to the 1970s, ecology was considered a branch of biology. Environmental science now focuses on the earth sciences and the technology of pollution, in addition to providing a firm foundation in ecological principles. Environmental studies go a step further; these studies deal with the interactions between environmental sciences, social sciences, and the humanities. As it is now recognized that technological solutions to environmental problems cannot be successful without concern for both their cultural and social impacts, environmental literacy calls for the broader range of disciplines embodied in environmental studies.

Environmental Education

ENVIRONMENTAL EDUCATION officially started in the United States in 1970 when U.S. Congress passed the National Environmental Education Act to promote teaching about the environment in K-12 classrooms. The first U.S. Office of Environmental Education was established in the Department of Education by the Nixon Administration. At the 1977 United Nations Intergovernmental Conference on Environmental Education in Georgia (at that time part of the U.S.S.R.), *environmental education* was formally defined as "a process of developing a world population that is aware of and concerned about the total environment problems, and which has the knowledge, skills, attitudes, motivation, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones."

As far back as in the year 1987 the Supreme Court in M.C. Mehta's case held that it was necessary to introduce compulsory environmental education from Class-I to Class-X. At least one class in a week should be earmarked for environment teacher. But the same has not yet been materialized. Of course, 4/5 years back some sorts of environmental education have been introduced in schools and colleges which was wholly inadequate.

Environmental education became popular in the United States in the 1970s, but its meaning changed over time. At first, environmental education was equated with education about nature, conservation, and the outdoors. Later, courses were added covering natural resources, environmental management, resource-use, and environmental quality. Then the curriculum was expanded to include education on energy, risk, environmental health, population studies, the global development. All of these kinds of education reflect why the term environmental education has been controversial since its inception: the environment means different things to different people.

Environmental Laws And Its Applications

ENVIRONMENTAL LAWS and regulations are based on the setting of standards for environmental quality and the implementation and enforcement of those standards. The Clean Air Act (1970), for example, includes many specific air quality standards that limit the emissions of hazardous air pollutants standards alone however are mere ideals. A stated goal is not a realized goal until activities designed to reach that goal are implemented and enforced.

The objectives of Environmental policy are :

- preserving, protecting and improving the quality of environment;
- protecting human health;
- prudent and rational utilization of national resources;
- promoting measures at international level to deal with regional or worldwide environmental problems.

The environmental law can be said to have three main functions:

- prevention ;
- setting environmental quality standards;

- clean-up/remediation.

The principles on which the environmental regulation is based are -

a. "Sustainable development";
b. The "preventive principle";
c. The "polluter pays principle";
d. The "precautionary principle".

a. Sustainable development

The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations. In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it. To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

b. Preventive principle

The preventive principle requires more forward thinking actions on the basis that 'prevention is better than cure' and steps should be taken to prevent or minimize the effects of pollution before the polluting process actually begins.

c. Polluter pays principle

The polluter pays principle is one which is aimed at ensuring that the costs of environmental damage caused by polluting activities are borne in full by the person responsible for such pollution i.e. the polluter. The principle means:

- the polluter should pay for the administration of the pollution control system; and

- the polluter should pay for the consequences of the pollution - for example, compensation and clean-up.

d. Precautionary principle

An examination of the "precautionary principle" serves to illustrate the uncertainty which surrounds all of the principles. The said principle means that -

> Where there are significant risks of damage to the environment, the Government will be prepared to take precautionary action to limit the use of potentially dangerous materials or the spread of potentially dangerous pollutants even where scientific evidence is not conclusive, if the balance of likely costs and benefits justifies it.

History of Environmental Laws

THE ENVIRONMENTAL movement, from which modem environmental policy and environmental law have evolved, began in 1962 with the publication of Rachel Carson's *Silent Spring.*

The birth of the modern environmental movement

Shortly after the publication of *Silent Spring* a controversy arose over plans by the Consolidated Edison Company of New York to build a pumped storage power plant at Storm King Mountain, approximately 50 miles (80 km) north of New York City on the western shore of the Hudson River. A pumped storage plant uses electric power to pump water from a river or other water source up to a reservoir several hundred feet higher. Power is produced by releasing water from the reservoir to flow rapidly down to the water source. Generally the power used to move the water up is about one-third more than that produced by the release of the water flowing down. The benefit comes from the fact that the power produced in this way is generated very quickly and thus serves as a supply during periods of peak power demand. When the company went before the Federal Power Commission (FPC) to secure the necessary permit, residents on the mountain joined forces with the New York-New Jersey Trails Conference, an affiliation of hiking clubs in the park areas of the Hudson Highlands. Together they organized the Scenic Hudson Preservation Conference to oppose the permit in the hearings before the commission. When the permit was granted, they took the battle to the U.S. Court of Appeals for the Second Circuit.

That court's historic 1965 decision marked the beginning of modem environmental law, although the term did not come into general use for another five years. The Court of Appeals reversed the prior decision and turned the matter over to the FPC. In doing so it first recognized that the Scenic Hudson Preservation Conference had the same right to petition the court as would any individual injured party. The court ordered new hearings by the FPC, stating: "The renewed proceedings must include as a basic concern the preservation of natural beauty and of national historic shrines, keeping in mind that, in our affluent society, the cost of a project is only one of several factor's to be considered."

Questions for the future of' environmental law

As the number of environmental statutes and regulations has increased, more and more questions have been raised over whether, and to what extent, traditional legal approaches - known as the command and control method--are superior to economic or market mechanisms. For example, the Clean Air

Act amendments of 1990 allow utility companies that reduce emissions of pollutants below the levels permitted to sell the allowances not needed by them to others that have difficulty meeting their limits in a process called pollution trading.

Another question that- is receiving increasing attention is, "How clean is clean?" As laws and regulations mandate a more pollution-free environment, the relative costs of the standards imposed become increasingly high. At some point it becomes necessary to weigh the costs of compliance against the benefits that meeting the standards are expected to achieve. It may, at times, be necessary to consider a compromise.

The development of environmental policy and law today requires balancing many factors and interests - including costs, economic development, the rights of minorities, and a complex of constitutional and other legal issues.

THE BODY of international environmental law has grown rapidly since the early 1970s and increasingly expresses human attempts to regulate their impacts on the earth's biosphere-the complex matrix *of* water, air, land, and living things that supports all life. The reason lies in the explosive growth of the human population and human economic activities. The world's population in 2000 was about 6 billion people and is increasing by about 1 billion per decade. Economic activity has grown even faster. It is estimated that world economic activity tripled between 1950 and 1990. It is predicted to triple again between 1990 and 2040, a ninefold increase in less than a century.

The beginning of international environmentalism

The first human impacts on the environment that were considered serious enough to deserve international attention were threats to migratory wildlife. Between the late nineteenth and mid-twentieth century, countries entered into a number of agreements to protect migratory species such as fur seals, whales, fish and birds. In 1954 growing coastal pollution caused nations to negotiate a treaty aimed at controlling marine oil pollution. In 1959 many countries signed a far-reaching agreement designating Antarctica as an international scientific reserve. Because many environmental problems could not be solved by anyone nation acting alone, the first UN Conference on the Human Environment was held in 1972 in Stockholm, Sweden. The conceptual guidelines for the conference - published as the book *Only One* Earth-greatly increased popular and governmental awareness of international environmental problems and the need for cooperative actions to address them more concretely, the conference established the framework for much of the international environmental law that exists today.

Soft law and hard law

In the international sphere, a nation is legally bound to do something only if it formally agrees to do so by becoming a party to a treaty or other international agreement. There is no higher power that can compel nations to act. However, international environmental nations to act. However, international environmental law has dimensions that extend beyond legally binding agreements. Because of the need to build consensus among nations before negations on an international treaty can begin, some form of what is known as soft law - advisories and statements of intent-commonly foreshadows and makes possible the legally binding statutes that make up the actual legislations, or hard law.

For example, Recommendation 86 of the Stockholm Conference called for the convening of an intergovernmental conference to agree on the text of a treaty to control the dumping of wastes in the oceans. The British Government convened such a conference almost immediately, and the Ocean Dumping convention was ready for signature a few months later on December 29, 1972. On the other hand, Stockholm Conference Recommendation 70 simply called on governments to "be mindful of activities in which there is an appreciable risk of effects on climate." Twenty years later, the issue of climate change had moved high on the international agenda, and a treaty on the subject was signed in June 1992.

There is a large body of hard and soft law concerning bilateral (two-way) relations between neighbouring countries, dealing with such problems as air and water pollution and shipments of Hazardous substances. There is also a body of law concerning the management of international lakes and rivers. Some of these water management agreements are the basis for important institutions, such as the International Joint commission, which was created by the United States and Canada to help manage the Great Lakes. Other international agreements have created major regional institutions, many of which have growing environmental responsibilities. Examples include the European Community (EC) and the Association of Southeast Asian Nations (ASEAN).

Environmental law and the atmosphere

Since the 1970s a great deal of attention has been devoted to human impacts on the earth's atmosphere. The problem of stratospheric ozone depletion due to emissions of human-made chemicals was first identified in 1974. The United States and a few other nations took unilateral (one-way, or independent) steps to reduce their emissions of ozone-depleting chemicals before 1980, but most of the other industrialized nations refused to do so that time. In 1985 the Vienna Convention for the Protection of the Ozone Layer established a framework for dealing with ozone depletion. Spurred in part by the frightening discovery of the ozone hole over Antarctica, nations in 1987 added the Montreal Protocol. In the spring of 1992, fifty-six nations endorsed amendments to the Montreal Protocol that would require industrialized nations to phase out their harmful emissions by 1996. Other amendments have created - a fund to assist developing nations in making the transition to chemicals that did not deplete the ozone layer.

The other major global atmospheric issue is climate change due to the greenhouse effect. Negotiations on a climate-change treaty began in 1990 under the auspices of the United Nations. The issue attracted wide interest, and negotiators from 143 nations agreed in May 1992 on the text of a treaty, the UN Convention on Climate Change, aimed at stabilizing the concentration of greenhouse gases in the atmosphere to minimize global warming. The convention, which was signed by 155 nations at the Earth Summit in Rio de Janeiro in 1992, requires industrialized nations to limit their emissions of', greenhouse gases. However, because it leaves to individual nations the decision as to what those limits will be, it does not impose firm targets and timetables for reducing greenhouse gas emissions. The convention states that the obligations of developing nations to control emissions will depend on the transfer of technological and financial resources from industrialized nations. However, the question of how those transfers will occur remains to be resolved by further negotiations.

At the regional level, the most important atmospheric problem is acid rain, which affect much of North America and Europe and is emerging as a concern in developing regions as well. In 1983 the International Treaty on Long-Range Transboundary Air Pollution, negotiated under the auspices of the UN

Economic Commission for Europe, went into effect. It promotes the international sharing of information and encourages research, but it does not require nations actually to reduce transboundary pollution. In part, this is because the causes of acid rain are not yet fully understood.

Pollution in Oceans and regional seas

The oceans have been a subject of concern for international environmental law at least since 1911 when national agreed on a treaty to protect migratory fur seals. In addition to treaties protecting wildlife, there are many global and regional agreements aimed at preventing marine pollution. Among the most important are the 1972 Ocean Dumping Convention, the 1975 International convention on the Prevention of Pollution from Ships, and agreements concerning liability and compensation for damage due to oil pollution.

In 1982, after many years of negotiations, 117 nations signed the UN convention on the Law of the Sea. This convention deals with almost every human use of the oceans, including environmental aspects such as pollution, fishing, and the conservation of marine resources. The United States and a number of other industrialized nations have refused to become parties to the convention because they disagree with its provisions concerning deep-sea mining. Nevertheless, the convention is very influential because even these nations agree with and adhere to most of its provisions.

At the regional level, the United Nation's Regional Seas Program has fostered separate agreements aimed at cleaning up ten marine regions: the Mediterranean Sea, the Persian Gulf, the Red Sea and Gulf of Aden, the Kuwait region, the wider Caribbean, the East African region, the West and Central African region, the East Asian seas, the south Pacific, and the Southeast Pacific. Outside this framework, important agreements also have been negotiated for cleaning up the North Sea and the Baltic Sea.

Toxic substances and hazardous wastes

During the 1970s many nations adopted domestic laws governing the transportation and disposal of hazardous materials. Nonetheless, concern grew about the effects of international shipments of hazardous wastes. In 1989 several nations completed negotiating the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their disposal. The Basel Convention, which went into effect in May 1992, prohibits the export of hazardous wastes unless there is a bilateral agreement between the exporting and the importing countries that ensures safe disposal of the wastes.

Wildlife and natural areas

International environmental law began in the late-nineteenth and early - twentieth centuries .with agreements to protect migratory species of birds, seals, fish, and whales. A treaty protecting polar bears was agreed to in 1976. The wildlife treaty that has produced the greatest controversy, however, is the International Whaling Convention, first agreed in 1931. After years of argument, the parties to the convention agreed in 1982 to a moratorium on all commercial whaling. Subsequently, however, some nations, dissatisfied with the moratorium, threatened to resume commercial whaling.

A major advance in wildlife protection occurred with the negotiation in 1973 of the Convention of International Trade in Endangered Species (CITES), in which nations undertook to cooperate by banning or restricting trade in animal and plant species that are designated by CITES as endangered or threatened. In 1979, CITES was supplemented by the Convention on Conservation of Migratory Species of Wild Animals, intended to protect animals that regularly migrate across national boundaries.

There also have been international actions to protect especially valuable natural areas. The Antarctic Treaty of 1959. which protected Antarctica as an international scientific reserve. generally has worked well to safeguard the fragile Antarctic environment. In 1991, thirty-one nations signed an amendment to the treaty that would essentially prohibit mining in Antarctica for fifty years. In 1971 the General Conference of the UN educational, Scientific, and Cultural Organization (UNESCO) endorsed the Convention concerning the Protection of the World Cultural and Natural Heritage. Under this convention, nations nominate natural areas "of outstanding universal value" for inclusion on the World Heritage List. The nations where these areas are located are obligated to protect them and are eligible for financial assistance from the World Heritage Fund in doing so. The Ramsar Convention, under which nations agreed to make efforts to conserve wetlands, went into effect in 1975. Under UNESCO's Man and the Biosphere Programme, initiated in 1971, hundreds of important natural areas in many nations have been designated as biosphere reserves.

Preservation of Bats

As the Bats are very much useful for the mankind as most of the Bat species consumes about 600 mosquitoes per hour with the help of natural radar, which is there in the Bat species, on 4th December 1991 the representatives of all the European. countries assembled in London and entered into an

Agreement on the conservation of Bats in Europe. The said agreement provided, inter alia, that each state shall prohibit the deliberate capture, keeping or killing of bats except under permit from the competent authority.

The said agreement provided in details for protection and preservation of Bats including protection of areas where they stay, and also to protect their food chain. The said agreement provided for research for their conservation and development as well as to create public awareness necessary for their protection. In India the picture is just the opposite.

The Bat Conservation International has prepared bat houses and open for sale. Bats like to live in old trees, caves and barns but not all of us have those handy. These bat houses are a perfect substitute. In India people have no idea about bats and bats in India has become endangered species. Government has no intention to protect it or to advise the people not to kill bat which indirectly eliminates malaria.

Desertification and deforestation

Desertification due to human misuse of rangelands and croplands affects large and growing areas of the earth's surface. In the Sahel region adjacent to Africa's Sahara Desert, desertification has reduced agricultural productivity and has brought additional suffering to millions of the world's poorest people. In 1977 the UN Conference on Desertification adopted a Plan of Action to Combat Desertification, but funding for the plan depends on voluntary contributions from nations and has fallen far short of official targets. The 1992 Earth Summit called on the UN General Assembly to set up negotiations for a more effective treaty to prevent desertification.

Because of concern about the rapid loss of tropical forests, sixty-four nations agreed in 1985 to establish the International Tropical Timber Organization (ITTO). Although the ITTO is concerned mainly with timber production and marketing, it is supposed to take account of the need for conservation. At the 1992 Earth, Summit, the nations represented agreed on an authoritative Statement of Forest Principles.

The Rio Conference and Beyond

The 1992 UN Conference on Environment and Development, or Earth Summit, in Rio de Janeiro was the occasion for the signing of major treaties concerning climate change and the conservation of biological diversity. The Rio Conference, attended by representatives of more than 150 nations, produced other documents that are sure to lead to future advances in international environmental law.

One result of the conference was the Rio Declaration, which outlines the relationship between environmental protection and economic development and states broad principles of environmental law, both national and international. For example, Principle 14 declares that nations "should effectively cooperate to discourage or prevent the relocation and transfer to other states of any activities and substances that cause severe environmental degradation or are found to be harmful to human health." Another major product of the conference was Agenda 21, a set of more than thirty detailed statements containing recommendations for action on virtually every subject of concern in the fields of environmental protection and economic development. The subjects of these statements range from combating poverty to technology transfer among nations to preventing deforestation. The Agenda 21 recommendations are soft rather than hard law, but they appear certain to exert great influence on the future development of .international environmental law, much as the

Stockholm Declaration did twenty years earlier.

Biodiversity

The term *biodiversity* is used to encompass the variety of life on earth. Most of the time the word is used to describe diversity of species and subspecies, for example: the diversity of birds includes about 9,600 species. However, biodiversity can also apply' to genetic variation within species or describe differences between populations of a species. It can also be applied to variations at higher levels of organization such as the community or within a biome (major ecological region).

Biological diversity has essentially existed since the beginning of life on earth. There has been a general tendency biodiversity to increase, although there have been a few moments of crisis when biodiversity has been greatly reduced. Such instances would include periods such as the end of the Pem1ian and Cretaceous periods. The Cretaceous period was the last period of the Mesozoic era and was marked by the disappearance of dinosaurs.

Originally biodiversity was viewed in terms of food, fiber, and materials for shelter only. Now, however, biodiversity has come to include a wide and growing set of resources such as paper, pulp and its derivatives, pharmaceuticals (drugs), latexes (plastic or rubber substances), resins, and essential oils. Currently biodiversity encompasses all of the biological resources on earth. Entire government departments and agencies are focused on various aspects of the biological resource base: agriculture, health, fisheries, forests and so on.

Biodiversity in nature is responsible for many public services generally treated as free by economic systems allover the world. These services include the major global cycles of energy such as the fixing of solar energy through photosynthesis. It also includes the cycling of water and such elements as carbon, nitrogen, and phosphorus. Regional processes such as the hydrological (water) cycle in the Amazon River basin can also be considered a service of biodiversity.

The human impact on biodiversity has in some cases promoted greater variety in strains of crops and domestic animals. Human impact in general, though, has been mostly negative because environmental problems also affect the state of biodiversity. In 'the beginning human impact was felt mostly through direct effects on specific species, particularly due to over-harvesting. In some other cases an undesirable species was deliberately eliminated. Most of the extinction generated by humans has been indirect. It has occurred through the destruction of habitat and the often unintentional introduction of diseases and predators. This kind of destruction has had disastrous consequences on island biotas (animal plant life confined to one island). Loss of the dodo (bird) is perhaps the most well-known example.

Bioenergy

Bio-energy is energy derived from plant matter-what is known as *biomass.* Green plants capture solar energy and store it as chemical energy. The energy is stored in the form of cell walls in the plants' stalks, stems, and leaves and as oils or starch in the seeds, fruits, or roots. Both plants and the waste materials derived from them-such as sawdust, wood wastes, and agricultural wastes-are referred to as biomass. Biomass can be used directly as a solid fuel to produce heat. It can also be converted to other energy carries such as liquid and gaseous fuels. Bio-energy encompasses a variety of renewable energy technologies 'that are locally available and used the world over.

Types of Pollution

There are different types of pollution such as -(i) air pollution (atmospheric pollution) (ii) water pollution (iii) solid waste pollution (iv) noise pollution. That apart there are various types of pollution which are required to be specifically stated such as radio-active substance pollution, land pollution, hospital waste pollution etc. First of all in the matter of pollution heavy industries contribute pollution in air and water as well as create noise pollution. Thermal plants contribute air pollution in the form of discharging fly ash which is injurious to health and creates respiratory problem. Solid wastes or municipal wastes create a great problem in our country inasmuch as the disposal system of the solid wastes in our country is not scientific and the municipal authorities do not have any infrastructure to tackle with the solid waste disposal. Tanneries' wastes include *chromium* which is carcinogenic. If the waste water discharged from tanneries is allowed to be drained out without effluent treatment and ultimately those waste water pass through drain and go to the stream then the entire water system will be contaminated. Radio-active substance poses a real threat to the society as it causes a serious danger to the human and other living bodies and even the trees. You are aware that the *atom bombs* that were thrown in Hiroshima and Nagasaki caused a great devastation which never occurred on the Earth and/or the Universe. The after effect of the nuclear bomb explosion made in 1945 is still continuing.

If one goes deeply into the environmental problems it would be evident that there are various other things, which creates pollution and which is causing threats to the existence of the mankind on earth. As for example (a) Heavy metal pollution of the atmosphere (b) Effect of smoke on climate (c) The Environmental injury to plants (d) Visitation effect of rising

Carbon monoxide in the air *(e)* Atmospheric ozone (f) Ozone absorption emission of radiation (g) Acid rain (h) Motor vehicle emission (i) Industrial emission and classical smog (j) Atmospheric effects of volcanic eruptions (k) Underground water contaminations and its sources (l) solid waste pollution (m) thermal pollution (n) radiation pollution (o) nuclear waste disposal (p) coastal pollution (q) marine pollution (r) physical control of insects (s) botanical insecticides, soaps, oils, plant resistance to insect.

Balance of Nature

The first thing in the field of pollution is that of maintaining of the balance of nature. The balance of nature is a thing which we have to know at the very beginning because some times we do something for the purpose of preventing or controlling of one thing but the adverse effect and the effect on the nature is not apprehended and/or understood. In 1960s, in an attempt to eradicate malaria of various types in Borneo the World Health Organization embarked on a major campaign to rid the tropics of the mosquitoes that carry the disease. The chosen pesticide which is known as DDT - a highly toxic and cancer-causing chemical since banned in most western countries but still widely used in the Third World. What has happened is that because of spraying of DDT in the malaria affected Part in Borneo the mosquito population reduced and fell down dramatically. But it was not only mosquitoes that died, numerous other species were poisoned by the DDT, among them a minute wasp that preyed upon caterpillars living in the thatch of local houses. With the wasp gone, the caterpillar numbers increased to plague proportions, devouring the roofs of houses and causing them to collapse. Nonetheless, the spraying programme continued. They dead mosquitoes were eaten by gecko lizards which, as they became sick, proved easy prey for the local cats. As a result the cats accumulated large quantities of DDT, passed on from insect to lizard to cat. The cats began to die in their thousands - and the local population of rats exploded. As there was no cat to consume rats, the rats not only are ate local crops but brought an even greater menace -bubonic plague. In order to control the rat population the Borneo Government called for cats to be parachuted into the worst affected regions. Even the top most health organization of the world -WHO, could not contemplate at the very beginning what would be the fate of use of DDT for the purpose of killing mosquitoes. This DDT has not yet been banned in India. Apart from water pollution and other types of pollution which is sought to be controlled by laws, there are various uncovered area of pollution which are of serious nature. As for example, pollution has entered into the food which ultimately comes to our dining table. Pollution has also entered into the field of Cosmetic also and the cosmetic which has been used by the ladies contained certain chemicals which is highly injurious. There is no legislation nor public awareness in respect of these pollution in India.

Acid rain and global warming

The problem of acid rain and global warming proves that pollution does not respect national barrier. Global warming caused by emission of green house gases such as carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide, is a major environmental concern and cannot be tackled on a fragmented national basis. It demands an international response. One country's pollution can be every country's predicament.

Environmental assessment

Now, in order to make any development work particularly setting up of industries at the initial stage it is necessary to make environmental assessment.

Environmental assessment is a special type of study as to how the project starting from road construction to installation of a power plant or any big or giant industries, project or other developmental works will effect the environment and in what manner. Environmental assessment study is made before any project is supposed to get clearance. Such assessment must take into account not only the impact of the project on the natural environment, but also its effect on human environment, as for example, on the quality of life in urban and rural areas. The environmental assessment is based on the assumption that the people are entitled to live in a healthy environment. No industrial work or other work can be undertaken if it amounts to environmental damage. The principle establishes that consideration of environmental matters must be more than a formal or Proforma ritual. Clearly, it is pointless to consider environmental cost, however, also seriously consider action to avoid them. Such a full exercise of substantive discretion is required at every important and appropriate stage of action. Environmental assessment also improves biodiversity protection. The old concept of biological diversity is now coined as bio-diversity. It. is the key to maintenance of the world as we know it. Species are disappearing at an accelerated rate through human action.

You all remember that few years back the Government of West Bengal had contemplated to set up a nuclear power plant at Sundarban for the purpose of making the State of West Bengal self-sufficient in the matter of production of electricity.

From Chernobyl incident we have learnt that an accident had occurred at Nuclear installation with depressing regularity, frequently releasing radioactive substances into environment. The most devastating accident to date took place in April, 1986 when the reactor at Chernobyl in Ukraine exploded. Hundreds of thousands of people had to be evacuated. Four years after the accident the people were still being moved. Level of radiation in areas as far as 400 KM (250 miles) from

Chernobyl were still between 8 and 15 times more than the background average. Trees close to reactor died, but further away they began to grow abnormally with strange roots and deformed leaves. Even in Bavaria in Southern Germany cows which have been allowed to graze outside had contaminated grass a month after Chernobyl accident showed three times as many as still-birth as animal can be indoor. Fall-out levels in parts of Britain were also high. One year after the Chernobyl accident five lakhs sheep in Cambria North Wales, Yorkshire and Scotland had to be banned from being slaughtered because their flesh contained more than one thousand bacquerels per KG. People living in the contaminated region of Ukraine were reported to be suffering from various illness and even in 1999-2000 it was found that the girls who were very young at the time of the accident in 1986 were giving birth to children with thyroid cancer. Several millions of people were seriously affected. There was huge death toll and it had a tremendous adverse impact on nature. That is why on 15th December 2000 the President of that State formally and finally switched off that nuclear power station. It was shocking that after all these things the Government and the Scientists were dreaming to have a nuclear power station in our country.

In the United States of America the first law to make environmental assessment was the National Environment Policy Act of 1970. In India there are laws, but not at all effective and things are not assessed as it is required to be done. In India the Central' Government has retained some power to grant permission in, respect of certain specified industries and the rest are in the hand of the State Pollution Control Boards.

The Government of India had issued a Notification dated 27.1.94 knows as "Environmental Impact Assessment Regulation". The said regulation laid down certain procedures for seeking environmental clearance from the Government of India for project mentioned in the Schedule-I to the said Regulation.

Atmospheric Disruption and Global Warming

For over a century, scientists and environmentalists have warned that rising levels of carbon dioxide, due to the burning of fossil fuels, could bring about a catastrophic warming of the Earth's atmosphere. But it took a succession of unusual wteather events around the globe, especially during the late 1980s, to alert public and politicians to the threat of global warming.

Without naturally occurring greenhouse gases, such as carbon dioxide (CO_2), water vapour, methane (CH_4) and nitrous oxide (N_20), the planet would be some 30^0c (55°F) cooler. These important gases allow short-wave energy from the Sun to pass through them, but trap the longer-wave infra-red or heat radiation which is reflected back from the Earth's surface.

Unfortunately, the levels of these greenhouse gases in the atmosphere are now rapidly increasing, mainly as a result of thc burning of fossil fuels and destruction of forests. The increased use of nitrogen fertilizers, the expansion of irrigated rice production and rising numbers of cattle are also playing a role.

Rising Sea Levels

Current estimates suggest that global warming could cause a sea level rise of anything between 7 cm and 165 cm (2½) ins and 5 feet 5 inch) by 2050, due to the expansion of the oceans as they warm up and the melting of glaciers and the Greenland and Antarctic ice caps.

A sea level rise of 1 m (3 feet 3 ins) could affect up to 300 million people. Especially vulnerable are the Nile and Ganges Deltas and island nations such as Maldives. Many major towns and cities -including London, Bangkok and New York - could be at risk. According to Gjerrit Hekstra of the Dutch Ministry of the Environment, if maximum storm surges and the effects of saltwater intrusion along river mouths are taken into account, a 1-m (3 feet 3 ins) rise in sea level could potentially affect all and up to the 5-m (16-foot) contour line. Worldwide, this would amount to an area of some 5 million km^2 (1.9 million square miles). This is only 3 per cent of the land area of the globe, but it includes a third of tire cropland.

Conserving Wetlands

Wetland in the past was considered as wasteland but in 1970s the value of the wetland was first understood by the scientist. In 1971, however, the urgent need to protect the remaining wetlands of the world led to the setting up of the Ramsar Convention, with the express aim of conserving the most important wetland sites. Wetlands are the only ecosystems to have their own intemational convention; a measure of the severe threat posed by their worldwide destruction.

But despite the good intentions, Ramsar has been hampered by lack of funds and political will. In 1988, almost two decades after it was drawn up, it still had no permanent secretariat and no regular source of funding. Of the 357 wetland sites that were supposedly protected under the convention -covering an area the size of Wales or just 2.5 per cent of all wetlands in the world -at least 20 were listed by the World Wide Fund for Nature as threatened. Moreover, many countries with major wetlands (Botswana and Indonesia, for example) are not signatories to the convention.

The wetland helps to maintain the ecological balance.

Because of their high productivity and their role as stepping stones for migratory species, particularly the birds, the world's wetlands contribute in untold ways to maintaining the health of numerous ecosystems. Indeed, the continual movement of animals into wetlands and then beyond in their migrations, acts as an effective means of dispersing the rich accumulation of nutrients into less productive areas.

Consequently, of wetlands has wide repercussions. Almost the entire population of North Sea herring is dependent, at some period during its life cycle, on the coastal wetland associated with the Wadden Sea, now seriously threatened by pollution. Indeed, it is believed that two-thirds of the world's fisheries are directly dependent on the fertility of coastal wetlands. In this respect, wetlands are particularly important in the Third World as food sources. In Africa, for example, one-fifth of all the animal protein consumed by local people comes from fish dependent on wetlands.

Wetland plants also absorb many other pollutants - pesticides and heavy metals for example - although there is a limit to the pollution that a wetland can tolerate before its cleansing properties are overwhelmed. There is also the danger that animals higher up the food chain may be poisoned, owing to the accumulation of pollutants in the animals they feed upon. Economists in the US have calculated that the water treatment and other functions carried out for free by wetlands are worth some $400,000 per ha ($160,000 per acre) - the amount it would cost to perform the same functions using man-made treatment plants.

Poisons from traffic - vehicular pollution is a slow murderer. The air pollution is made from various sources like industries, thermal power plants, and transport. The pollutants emitted from these sources are mainly (a), sulpher dioxide (b) carbon monoxide (c) hydro-carbon (d) nitrogen oxide and suspended particulate matters and leads. The carbon monoxide goes to ozone layer and ozone depletion is caused.

The car emission discharges dangerous pollutants which contaminate city air to include Nitrogen-dioxides which irritates the lungs and can cause *bronchitis* and *pneumonia.*

Nitrogen-dioxides also contribute to the formation Ozone in the air around us, which is a major health hazard as well as being poisonous to trees and crops. At low altitude ozone is formed by sunlight acting on hydrocarbons (which are released with industrial and vehicle emissions) mixed with nitrogen oxides in the air. Ozone is the major constituent of photochemical smogs which are notorious in cities like Los Angeles; and Mexico City, where there is heavy traffic and long periods of windless, sunny weather.

Air Pollution

Other dangerous pollutants which contaminate city air include carbon monoxide, lead and toxic hydrocarbons, such as benzene, toluene and xylene. Some of these can cause cancer, reproductive problems and birth defects. Motor vehicles are responsible for producing 85 per cent of carbon monoxide pollution which, at high concentrations, deprives the body of oxygen, impairs perception and thinking, slows reflexes and causes drowsiness. Around a half of all city dwellers in Europe and North America are exposed to unacceptably high levels of carbon monoxide according to the WHO.

Use of Chemicals and pesticides

For survival of the human being, animals and all other living beings on earth requires clean air and clean water should be the basic human rights the world over, but they are becoming increasingly scarce and expensive commodities. Indiscriminate use of chemical manures, pesticides and fungicides causes a serious threat to human life.

One well-defined health problem that has shown a steady increase due to pollution of our air, water and food is causing various illnesses. Pesticide residues in full are one factor. In 1987, the US National Research Council warned that 90 per cent of the fungicides in use of the US could be carcinogenic, along with 30 per cent of insecticides and 60 per cent of herbicides. The yearly increases in the incidence of asthma are likely to be linked to steadily increasing air pollution, particularly car exhaust fumes. In other diseases, such as lung infections, pollution is a contributory factor. In the US, deaths from chronic lung disease have increased by more than a third since 1970.

Effects of deforestation

Deforestation is the conversion of forest land for non-forest use. Such land was converted into agricultural land or used for dams, highways, airports and residential or industrial development. Trades in timber have also resulted in felling of valuable and costly trees. Deforestation is also carried out by Governments with the intention to sell the trees for timber and took the land for the purpose of growing export crops, (cash crops) such as coffee, tea, rubber, palm oil or sugar. The world popula,tion continues to grow and with it the need in most countries to grow more food. This means that deforestation could not be halted in the foreseeable future, unless the attitude of Government is totally changed and strong legislation with heavy penalty is made as well as to create awareness among the people at large in the country. People are not aware of devastating consequences that will follow on earth because of deforestation.

Forests play a vital role in protecting soils and regulating water supplies. Although soil erosion in deforested areas of the temperate countries is a problem, it is as nothing compared with the degradation caused by forest clearance in the tropics. To understand why, we need to look beneath the tropical forests, at the soils on which they grow.

Because tropical forests generally lie on infertile soils, deforestation quickly leads to essential nutrients being leached out of the soil, and can transform the land into a wasteland, denuded of all but the most unpalatable grasses. Typically, as much as half the soil's organic content is lost just three years after clearing the land for agriculture.

The concentration of CO_2 in the atmosphere has increased by more than 25% since the start of the industrial revolution in the mid-nineteenth century., Most of that increases has been a result of the combustion of fossil fuels (coal, oil and gas), but about one-third of the increase was contributed through deforestation. When forests are cleared and replaced with agricultural lands, the 'carbon originally held in the trees is released to the atmosphere either immediately if the trees are burned, or more slowly with the decay of organic matter not burned. Cultivation of forest soil similarly oxidizes the organic carbon held in the soil and releases it to the atmosphere as CO_2. When the area of forest is expanded, or when logged forests regrow, the net flux of CO_2 is reversed. Growing forests withdraw carbon from the atmosphere and accumulate it again in trees and soil.

It is important to recognize, however, that fores,ts are not the "lungs of the world", as is often stated. Young vigorously growing forests withdraw carbon from the atmosphere and *store* it in wood and soil. At the same time, they release oxygen to the atmosphere. A molecule of oxygen is produced for every molecule of CO_2 consumed. As forests mature, however, the rate of accumulation of carbon (or the production of oxygen) diminishes significantly.

Forest and Climate

Remote as the destruction of tropical forests and their peoples might seem to the inhabitants of far away cities such as New York, London or Tokyo. They, too, may be gravely affected by the wider climatic implications of deforestation. Forests contain massive amounts of carbon, and deforestation, especially when the forests is burned as happens on such a large scale in Latin America, adds considerable quantities of carbon dioxide to the atmosphere. Deforestation is thus adding appreciably to the greenhouse effect with devastating consequences for both North and South. So extensive is the forest clearance in Amazonia that Brazil alone could be releasing 500 millions tonnes of carbon a year, far more than previously estimated.

Deforestation may also disrupt another vitally important climatic mechanism. Between half and three-quarters of the rain falling over Amazonia is returned promptly to the atmosphere, both through evaporation from wet foliage and through transpiration - the process whereby plants take up water from the soil and lose it through, the stomata (breathing pores) in their leaves.

In the tropics, this vapour like perspiration, serves to cool the plants down so that they can continue to photosynthesize. It also provides at least 50 per cent, and sometimes as much as

80 per cent, of the rain that precipitates downwind, as such clouds are carried westwards towards the Andes. The same moisture falls as rain, evaporates and falls again, many times on its journey across the forest. Deforestation in eastern Amazonia could fatally disrupt this recycling process, causing the remaining forests of western Amazonia gradually to dry out.

Urban Forest

An urban forest is a collection of trees - and related plants and other natural resources - in and around a city. It can include street and yard trees, park trees, and tree stands in newly, expanding suburbs. Urban forests are natural resources that provide much value to people in cities and towns. These forests have both ecological and social benefits although unlike rural forests - they do not provide wood products.

Some of the benefits of urban forests are only partially understood. but, the ways in which these benefits can be measured scientifically are rapidly developing. The benefits can be placed into three categories: ecological, social, and health-related. The ecological benefits include the maintenance of air and water quality, the conservation of soil, and the provision of wildlife habitat. The benefits produced by urban forests are directly in proportion to how much tree cover they provide; the larger the biomass (living plant matter) produced by the trees, the larger the benefits produced.

Social benefits include the improvement of the appearance of the community. Trees give some sense of pride to a community and bring people together. They provide areas for recreation, planting, and education.

Public health benefits are also provided by urban forests. In recent years, researchers have documented the healing effects of trees on hospital patients. Patients with a view of trees come out of the hospital faster and use less pain medication. The public health value cian be expanded to include local parks and greenways. These areas provide soothing scenery and recreational space as well as a more pleasing overall environment.

Well-being and the environment

Life quality, including individual well-being, and the natural environment are intimately linked: the quality of life affects the environment, and the environment affects life quality. This linkage occurs on two levels. The first involves long-term causal effects and is most clearly visible over time and at macro levels for units such as whole societies, major geographic regions, or the planet as a whole. The second linkage operates at a more micro level and addresses short-term or immediate cross-sectional relationships between environmental factors and individuals well-being.

Hope for the future

In recent years, researchers have begun to experiment with native systems of cultivation. They are trying to adapt them to the needs of growing populations in the tropics. A general term for these agricultural systems is *agro forestry* that is mixing trees with crops and animals. One example is alley cropping. In this system, hedges. Several times each growing season, the branches of the shrubs are lopped off. The litter forms a mulch that improves the soil and increases its fertility. The trees also serve as a source of firewood and construction material for local villages.

The world's tropical rain forests are in great danger. Over half of the original forest cover has been destroyed and the rate of deforestation is increasing. According to one estimate, 65 acres (62 ha) of forest are lost every minute. Continuation at this rate would be catastrophic. Tropical rain forests are home to some of the most important species on earth. They also play a vital role in regulating the climate and making the planet habitable.

Concern over the loss of tropical rain forests should not prevent their use for human benefit. Many people already depend upon forest products and services, or upon tropical lands used for cultivation, colonization projects, hydroelectric projects, charcoal, pulp, pasture, and agricultural projects. There are ways to manage the forest without destroying it. However, such management requires an understanding of how tropical rain forests work. This knowledge must be incorporated into management practices. With care, humans can use the tropical rain forest without destroying it. All over the world people are conscious about the role of the forests and trees and efforts are being made to protect the forest and the process of restoration of the forest has started. In India we are lacking behind in this regard. The authorities are still following the path deforestation and indiscriminate cutting of trees in the name of development wlthout having any regard to the environmental impact.

Conclusion

If we keep on our current course of environmental exploitation, the question is whether the modern society will survive in the next century, or will it disappear with a cry? If industrial society goes out. it will be due to a combination of environmental degradation. food shortages and diseases.

Although the Third World may initially suffer most from environmental shocks, ultimately it is better equipped for survival. With the supermarket shelves empty, the inhabitants of New York, London or Paris would starve. But those who knew how to live off the land, however poor they might be, would inherit the Earth.

The Mind And The Environment – A Continuous Interplay

Nandini Chakraborty

> *By the mind of man we understand that in him which thinks, remembers, reasons, wills.*
>
> *- Reid*

It seems rather obvious to all of us that the environment should affect minds. There has been a lot of talk in the media about how sound pollution makes one irritable or how the indiscriminate exposure of young minds to violence on television is responsible for the aggressive tactics in the present generation. Even before the present media hypes and scientific studies, people believed (and still believe) that it is upbringing which makes a person the way he is. Our `upbringing' is the primary environment we are exposed to. Environment is the totality of our surroundings - social, physical and emotional. The family and later the friends we keep are supposed to be the foundation of what makes our personalities.

But the interplay of minds and the environment is more complex than the process of waves beating upon rock to carve out a structure. Our minds can also affect the environment and that is what makes things more interesting.

Firstly - is the environment a self contained compartment that we gaze upon through the windows of our eyes ? I would disagree. Much of our surroundings, both animate and inanimate is what our minds make it out to be. For a depressed person - the sunniest day could look bleak; colours look brighter and vibrant when one has had a whiff of cannabis; for a schizophrenic the simplest things could carry the most bizarre and complex messages. Red could be perceived as green by a person who is colour blind. A cheerful person looks upon most people around him as friendly, a depressed person thinks that no one cares; a paranoid person always smells danger. Our environment is not something that exists solely outside us, surrounding us - a lot of it is a product of our own minds, a projection of our thoughts, the way we see things in our particular light. Talking philosophically- is mind a product of matter organized in a particular way or is matter what mind makes it out to be? Or are we yet to arrive at a satisfactory answer? As Kant states, what we experience is 'ding-an-sich', the tip of the iceberg. Our conscious thoughts and perceptions are a result of a lot more of unconscious impulses that we never come to perceive.

Our minds and actions can also change environments substantially to affect other people around us. A person, who loses control over his drink, comes home every night to terrify and terrorize the lives of his timid wife and innocent children. The irresponsible citizen, who throws a banana peel on the pavement, leaves a hazard for an unsuspecting individual. A group of enterprising neighbours, who can work as a team, can change the locality they live in, into a haven of green.

And how (in the simplest way that we can interpret this) can the environment influence the mind? In a thousand and one ways one would agree, rather anyone would agree.

Right from the time a child is born, the society that he lives in shapes his attitudes, values and outlook. The family, which he belongs to, teaches him what to expect from life and what to give and take in a lifetime. A family shapes his lifestyle, his ambitions, and his expectations. But then, does a boy learn to be violent when he observes his father becoming aggressive after a drink ? Does he learn to drink and smoke from an early age because his brothers do ? Or is it because he shares genes with his father and brothers ? How much of our behaviour do we learn from our family and how much we inherit is a matter of debate that we will possibly never reach a consensus upon. Families share both blood and the environment in which they live. Trying to separate the effects of both is an effort for many researchers. But interestingly the scales are more in favour of the genes in most instances. Alcoholic parents tend to have more alcoholic biological children, even when the children are raised by non-alcoholic foster parents. More so in the case of diseases like schizophrenia and mood disorders, biological parents and children share more similarity than adopted families. Twin studies show that identical twins who are reared apart, share more similarity than fraternal twins in similar circumstances, thereby proving the importance of genetic influence. The 'nature-nurture' debate as it is called has always existed within developmental psychology.

And then comes the question of the neighbourhood. People talk about `unruly neighbourhoods' with gangs of rowdy teenagers and quarrelling crowds; and genteel neighbourhoods which house `cultured' and educated families.

Children are supposed to learn what they see and thereby the company they keep and what they observe around them is taken to be important. But there remains truth in the saying `birds of the same feather flock together'. Do children become `bad' if they unfortunately come into contact with an unruly gang, or do they tend to choose the group of people who suit their tastes ? It can be quite difficult to differentiate. Did their parents choose a particular neighbourhood because of the dictates of their genes ?

Much of our behaviour is determined by our biology, more than we are consciously aware of.. Much of our environment can be shaped or chosen the way nature intended us to.

But it would be unfair to say that the environment is clay in our hands. When a starving mother from an area devastated by drought, sells her child, she is hardly following the dictates of her heart. When year after year of natural calamity stagnates progress in certain parts of the world, poverty can dry out all the instinctive softness of human nature. When entire communities break down in depression and post traumatic stress disorder after a super cyclone or earthquake, it is nature proclaiming that he is not ready to be dictated to by human power or ingenuity.

At the centre of all our behaviour lies what we call 'personality'. Gordon Allport defines personality as 'the dynamic organization of those psychophysical systems that determine his or her unique adjustment to the environment'. Personality again, is made of up various components which include temperament, character and intellectual level.

Temperament constitutes the emotinal core of personality. 40-60% of this core is said to be of genetic inheritance and another 40-60% is influenced by a random environment.

Character is on the other hand the conceptual core of personality. 15-40% of character is genetic, 30-35% is influenced by family environment and 25-55% is influenced by random environment. Random environment implies the environment outside the family circle which is of significance to the individual. Intellectual ability or intelligence further modifies our behaviour. In other words, temperament rules our instinctual automatic behaviour, while character is more voluntary, more built from the values we imbibe as we grow up.

It would seem from this description of personality that genetic inheritance does constitute the basis of mind and behaviour but the influence of environment is still undeniable and significant. Twin studies show that twins reared apart, still share personality traits in 60-70% cases, but religious and political convictions to around 10-15% cases. This gives us an idea about what characteristics are more influenced by genes, and what is more environmentally imbibed.

There are other simpler and more obvious ways that environment can shape the ways of a person or his community. Communities living beside rivers in fertile silt laden land turn to agriculture, people living in hills with stretches of green meadows tend to flocks of animals. The land which we inhabit shapes our major occupations and food habits. It influences our major festivals, decides our routine through the year. This fact would still hold true for most of the world inspite of the fact that with extensive urbanization and globalization, our lifestyles throughout the world hold an ever increasing similarity as time goes by. Even that is the effect of a modern environment where the world becomes a smaller place to live in with every passing day.

The conclusion is obvious. Our minds are the products of interplay between our external environments and our genetic inheritance. The environment in which we live is also influenced both by nature and the people who live in it. It is harmony and balance between the two which can lead to the ultimate self actualisation we strive for.

An Environmental Movement Against The 'Greater Common Good'

Sabyasachi Chatterjee

The executors of the developmental projects always say that the particular projects are taken for the 'greater common good'. This attitude is evident from the following comments and observations.

>'*If you are to suffer, you should suffer in the interest of the country'.* (Jawaharlal Nehru, speaking to villagers, who were to be displaced by the Hirakud Dam, 1948).
>'We are told that it's being done for the sake of the Greater Common Good. That it's being done in the name of Progress...' (Arundhati Roy, The Greater Common Good, **Frontline**, June4, 1999, pp-8-9).
>"The entire 'development' discourse was run by experts, middle class professionals who stood for the state, and through the state for the nation. Politicians and bureaucrats added their own flavours. All this was done in the name of the masses, who 'entered the picture only as the somewhat abstract ultimate beneficiary". (Deepak Kumar, Science and Society in Colonial India Exploring an Agenda, **Proceedings of the Indian History Congress: Diamond Jubilee Session,** Calicut, 1999, p-446).

This same logic is used in almost every anti-environmental 'developmental projects'. The local people had to face the pollution hazards that were created by these so-called developments. In this particular case the people voiced earlier, and this had an effect in a positive way.

The Sunderban Fertilizer Limited, a chemical fertilizer company was proposed in the Dhola Road near Lakshmikantapur in Sunderban area, to manufacture 33000 tonnes of Sulphuric Acid per annum and 66000 tonnes of Single Super Phosphate (S.S.P) per annum of which 40% would be granulated. The Company in its official project profile[1] cited some justification for the production of SSP. Those were :

(i) Single Super Phosphate (S.S.P) was the cheapest source of phosphatic fertilizers in the country. Moreover the technology of the other main phosphatic fertilizers was quite difficult and capital investment was very high.
(ii) The Union Government was subsidising the SSP and the excise duty was nil.
(iii) SSP had sulphur and calcium content, which were micronutrients. Sulpher also acted as a pesticide by imparting protection to the crop roots. Calcium helped in reducing alkality of the soil. It was to be used as a fertilizer for almost all the crops, namely potato, jute paddy, wheat, maize, sugarcane, cotton, edible oils, pulses etc.

The Company argued that Sunderban area was agriculturally and industrially neglected for the last forty years after independence and this project was proposed to improve the socio-economic structure of the common people of this area.

But the common people, for whom, the project was said to be initiated, were not satisfied with the argument of the company.

They raised some basic questions. They said that the proposed site for the production of such a dangerous product had been selected most arbitrarily, violating all scientific norms for site selection and completely neglecting the environmental aspect, the impugned site being –

- very close to thickly populated villages;
- on the sides of the agricultural land;
- immediate next to a waterway which was part of the integrated water network of the Sunderban area;
- within a mile of a deep tube well, which was the main source of drinking water for the entire area.[2]

Along with that, they said that the manufacturing process of S.S.P would exhaust polluted smoke. The chemical reaction between Calcium Phosphate and Sulphuric Acid would be responsible for this pollution. The dust would pollute the air and water and agricultural land of nearby area would be polluted in this process. Sulpher dioxide would pollute the air and that would create diseases like chronic bronchitis, pulmonary emphysema etc. Phosphorus would enter the human body and that would create the disease in the kidney. In the manufacturing process some other pollutants would be released such as fluoride and Ammonia gas that would create flurosis disease in teeth& bone and damage in cornea respectively.[3]

On a whole the people said that the pollution would destroy the prevalent eco-system of the Sunderbans. It would affect the agriculture and fisheries. The chemical waste would pour into the water and in the long run would destroy the aqua-lives.[4]

This argument of the people had the conformity with the governmental views. The then minister of Sunderban development categorically mentioned in an article that some steps could be taken for the development of Sunderbans without disturbing the natural environment.[5] So the Company could not justify its claim that this project was proposed to develop the area.

Moreover it also violated Environmental acts and rules[6] such as:

- The Factory Act of 1948 (amended in 1987).
- The Environment (Protection) Rule, 1986 No.5 under Environment Protection Act.

In the *Factory Act*, it was clearly stated that if any hazardous manufacturing process was to be initiated, such as a phosphate fertilizer company, a site appraisal committee was to be made. This committee would be empowered to grant the project after carefully analysing the possible effects of that particular industry on the environment of the surrounding areas. The committee would be consisted of representatives of the central and state pollution control board, environment department, planning department, occupational health experts, scientists, and representative of local administrative authorities. But this company did not form any such committee at all.

In the Article 48, Section B it was said that the company had to inform the general public in vicinity about the project in details. That was also not done. So, there was a gross violation of the *Factory Act*.

The Environment (Protection) Rule, 1986[7] No.5 under *Environment Protection Act* categorically stated that the government might take into consideration the following factors while prohibiting or restricting the location of industries and carrying on of processes and operations in different areas:

(1)Standards for the quality of environment in its various aspects laid down for an area.

(2)The maximum allowable limits of concentration of various environmental pollutants (including noise) for an area.

(3)The likely emission or discharge of environmental pollutants from an industry, process or operation proposed to be prohibited or restricted.

(4)The topographic and climatic features of an area.

(5)The biological diversity of the area, which in the opinion of the central government needs to be preserved.

(6)Environmentally compatible land use.

(7)Net adverse environmental impact likely to be caused by an industry, process or operation proposed to be prohibited or restricted.

*(8)*Proximity to a ... sanctuary, national park...as such under the *Wild life (protection) Act 1972.*

(9)Proximity to human settlement.

(10)Any other factors as may be considered by the central government to be relevant to the protection of the environment of the area.

In this case all these factors, especially No.5 to 9 were very much relevant. To save their environment, the local people opposed the initiative to establish the chemical fertilizer company.

Along with the environmental question, the issue of land question has to be noted here. The proprietors of the company bought the land from the owner and then evicted sharecroppers. Two sharecroppers, Jayamalya Sardar & Kundapada Choudhury were evicted by the company management. They were told that the landlord in Kolkata had already sold the land to SFL. When the sharecroppers protested and said that they had necessary papers under operation Barga to continue their cultivation, they were beaten up in the local police station.[8]It was an instance of violation of the land rule that clearly stated that if the lands were sold yet the sharecroppers should have the right to till the land. Violating this act, the SFL took away the occupation of thousands of landless farmers.

The movement started with a refusal of selling the lands.[9]The SFL started purchasing land in the darkness of the night. While the market price for a bigha of land was around Rs. 3000/-, SFL offered Rs.5000/- and even Rs. 10000/- for bigha. The then local Congress M.P and C.P.I. (M) M.L.A helped SFL to buy the required lands.[10] SFL started purchasing the land even before the Pollution Control Board cleared the project. Ultimately, the *State Pollution Control Board* and the *Ministry of Environment* sanctioned the plan to set up the factory despite the Sunderbans being declared as a biosphere. The then member secretary of the State Pollution Control Board reportedly said that they were under tremendous pressure to clear the project.[11]

The protestants who formed the *Mandirbazar Dushon Pratirodh Committee* (MDPC) were of the opinion that the toxic waste from the factory would render cultivable land fallow, deplete forest resources and cause acid rain.[12] So the battle began. The battle had been fought in many levels. The *Bijnan O Bijnankarmi*, organ of the *Scientific Workers Forum, West Bengal* protested against this venture in the March-June 86 issue.[13] On 5th January 1987, the MDPC sent a 'memorandum'[14] to the Prime Minister and other concerned ministers at both the central and state levels citing the reasons for their opposition. There, MDPC referred to the observations made by the Supreme Court of India in the famous *Public Interest Litigation* on environment, i.e., the case of *M.C.Mehta*

& others vs. Union of India[15] which said: "We would, therefore, like to impress upon the government of India to evolve a national policy for location of chemical and other hazardous industries where population is scare and there is little hazard or risk to the community, and when hazardous industries are located in such areas, every care must be taken to see that large human habitation does not grow around them. There should preferably be a green belt of 1 to 5 K.M. width around such hazardous industries."

Along with this formal protest, street plays,[16] slide shows, seminars and workshops, poems, songs, posters, bulletins, pamphlets and science magazines were used in the battle for environmental protection. But perhaps the sharpest weapon in this battle was the people's refusal of selling land.[17]

Ultimately, through this movement, the people's power won the battle. After a prolonged struggle with the local masses, the SFL was compelled to give up. In a meeting of June 1989, the board of directors of SFL passed a resolution to change the site of the factory and empowered the vice-chairman of the company 'to arrange to sell the existing land at Dhola Road, Lakshmikantapur at suitable price on negotiation'.[18]

The success of the movement showed the power of the common people, the majority of which were peasants. They also got the support from the intelligentsia. In the course of the movement the activists had received the support from scientists, scientific workers, science magazines, writers, journalists and school, college and university teachers. Among them Dr. Rabin Majumder of Rajabajar Science College,[19] C.U. and Soumen Guha of *Scientific Workers Forum, West Bengal*[20] deserved special mention. Two noted writers had used this movement as a theme in their literary works. Sunil Gangopadhyay wrote a novel *Dhulibasan*[21], where the course of the movement was vividly described. Jhareswar Chattopadhyay also used this movement as a subject in his short story *Chimni*[22]. Noted writer and activist Mahasweta Devi in her weekly column in a vernacular newspaper[23] launched protest against this anti-environmental so-called developmental project. Her writings inspired the activists. Thus the movement got support from various quarters-from the sharecroppers to the urban intelligentsia. The upper strata of the political leaders including the local M.P and M.L.As allegedly helped the company but the local political workers were with the movement. Thus two very pertinent questions emerged: (a) Are the representatives truly representing their electorate? (b) Is their notion of 'greater common good' really good for the commoners?

The entire issue involved a bigger question of protest and awareness of pollution control in India. Apart from taking the help of governmental measures, a serious progressive public opinion of both the educated and uneducated is always present in the context of environment. The protest is almost autonomous and a major portion of intelligentsia including the petty bourgeoisie are supporting and often leading along modern lines. After the Bhopal Gas Tragedy (1984) the local movements are inspired by the protest movements against industrial pollution as a whole. The help of the media and judiciary are sought for this purpose. The involvement indicates an optimistic built-in pressure in favour of preservation, pollution control, reclamation and ecological balance. This will facilitate a more healthy earth. The case study indicates this growing importance of popular concern in any development endeavour.

Thus, in this chapter several important issues like the growth of rationalist movement in West Bengal to the development of people's protest against pollution have been discussed. All these aspects have an importance of their own. At the same time, all these movements, including the case studies, are focusing on the growing significance of the science movements in West Bengal in general.

Notes and References

1. Sunderban Fertilizers Limited: Prospects & Project Profile (For Private Circulation only).
2. Letter to Minister-in-Charge, Department of Forest & Environment, Government of W.B, p-5.
3. Deepak, **Paribesh Sachetanata: Prasanga-Sunderbane Prastabita Sar Karkhana** (Environmental Awareness: Context- The Proposed Fertilizer Company at Sunderban), Calcutta, 1987, p-9.
4. Ibid., pp-9-10.
5. Provas Roy, *Krishi Unnayanmulak Antarjatik Sahajogitay Sunderban Unnayaner Bishes Udyog* (Special Initiatives of Sunderban Development with the Co-operation from International Fund for Agricultural Development), the **Paschimbanga**, December 7, 1979, pp-453-456.
6. Deepak, op.cit., pp-22-24.
7. Notification No. S.O. 844(E) dated 19th Nov 1986 published in Gazette of India Extraordinary, Part-ii, Sec-3 (I) dated 19th Nov 1986.
8. Interviews with Jayamalya Sardar, Dec 5, 1999.
9. Interviews with Bishuddhananda Purakait, Joint Secretary, MDPC, Aug 30, 1999.
10. Interviews with some farmers & leaders of the movement, Dec 5, 1999.
11. Tamal Bandyopadhyay, *People Power: On the War Path*, **The Illustrated Weekly of India**, Sep 3, 1989.
12. 2nd leaflet of MDPC, Feb 1987.

13. Soumen Guha, *Rasayanik Karkhanar Dushone Ebar Sunderban*
(Now Sunderban under the threat of chemical factory's pollution), the
Bijnan O Bijnankarmi *(B.O.B)*, vol. 9, No. 5, March-June 1986.
14. For detailed text of the memorandum see the Bengali version of it in
B.O.B, vol. 10, No. 4, Jan-Feb 1987.
15. Writ petition (Civil) No. 12379 of 1985.
16. Interview with Tamal Kanti Halder, the director of the drama '*Kangsa, 5th June & Baidyanath*', Dec 5, 1999.
17. Interviews with Jharna Sardar & Bishuddhananda Purakait, Dec 5,1999.
18. Resolution of the Board meeting of M/S SFL held on May 25, 1989.
19. Editor of *B.O.B* who supplied scientific data regarding the harm of pollution that make the ground of the movement stronger.
20. The first person, who wrote on this issue in a periodical (i.e.-*B.O.B)*.
21. First published in the Puja-number of **The Anandabazar Patrika** 1989, then published as a book in Jan 1990.
22. Published in the Puja-number of the **Pratikshan**, 1989.
23. *Janla Khule* (To open the window) column in the Bangla daily the **Bartaman**, Sep 12 & 19, 1987.

Water Resource in West Bengal: Our Present and the Future

Kalyan Rudra

Introduction

The world is fast running out of fresh water, our demand for this 'blue gold' is increasing at a faster pace with passing time and thousand more people are compelled to survive in a water-stressed condition. One-half and two-thirds of the global population will be put to severe fresh water crisis within next quarter century, if we do not change our present wasteful mode of water- use (Barlow and Clarke, 2003). The corporate sector treats water as a commodity. It is human need, not right - they proclaim. The idea of selling water to the highest bidder denies the basic fact that water constitutes the fundamental component to all life forms and cannot be therefore, treated as a saleable commodity. It is an integral component of all ecological and societal processes.

Our planet is apparently rich in water but about 97.5 per cent of its water resource is saline as such unsuitable for drinking or irrigation. The volume of fresh water is only 2.5 percent of the total and that too is not readily accessible. About 68.7 per cent of fresh water is piled up in high latitude and altitude as snow and glaciers and 29.9 per cent is remaining as ground water and soil moisture. The global hydrological cycle operates through successive stages involving the evaporation-condensation-precipitation of 568000 km^3 of water annually. The continents of the Earth receive 42750 km^3 of water as precipitation, of which 32 percent falls on Asia (Gleick, 1993).. India gets 4000 km^3 of water (0.70 per cent of the global or 9.36 per cent of the Asian precipitation) annually as precipitation but our country renders home to about 16 percent of world's population on 2.45 per cent of the terrestrial surface (NCIWRD, 1999):. The total rainfall, if evenly spread, can submerge the country with a sheet of water having depth of 1.20m. The distribution of this natural resource in India is spatially and temporally so uneven that hydrological extremes of flood and drought are annual events in some parts or the other. When Cherapunji receives more than 11000mm of rain annually, large parts of Rajasthan receive less than 200mm of rainfall. The south-west monsoon virtually generates more than 80 percent of annual precipitation in this country and that pours during the months of June-September. But a single cloud burst over a place can generate more than 60 percent of annual rain within a span of just 48 hours. The most of monsoon rain in this country if clubbed together virtually occurs over a matter of 100 hours or so (Agarwal , Narain and Khurana, 2001). The management of spatially uneven and temporally skewed rain-water in India is the most serious challenge for the water-managers of this country.

Water Use in India

One-sixth of this nation is declared as drought-prone but almost one-third of the same suffers from acute water shortage in every summer season and not less than 270 million people struggle for their livelihood in a parched condition. It is officially admitted that 40 million hectares of land or about 12 percent area of the country with a population of 60 million is prone to annual flooding (Rudra, 2004). The structural measures like dams and embankments have not only failed to ensure due protection against flood, but have rather aggravated the situation in many areas (Agarwal and Narain, 1991, Mishra, 2002).

India is bestowed with 4000 cu km of fresh water annually, from precipitation. Excluding the evaporation, infiltration and interception losses, the available surface water, officially amounts to 1869 cu.km. - 37 percent of which (i.e. 690 cu. km.) can be utilized for beneficial purposes in addition to 432 cu. km. of annually replenishable ground water. Thus the total water available to meet our demand is officially estimated to be 1122 cu. km. (NWP, 2002. India, 2003). The annual per capita available water in India has steadily declined from 5177cu.m in 1951 to about 1820 cu.m in 2001 and continues to dwindle further with the exponential growth of population. The total demand in this country will be equivalent to utilizable fresh water resource by the middle of the 21st.century (Bandyopadhyay et al, 2002). The Government admits that 190 million people in this country still do not have access to safe drinking water. Again, 80 per cent of the children suffer from water borne diseases and 0.70 million of them die each year. Moreover, 44 million people suffer from diseases related to the consumption of poor quality of water (Shiva et al, 2002).

Present Status of Water Resource in West Bengal

West Bengal covers 2.7 per cent of the national territory and renders home to 8 per cent of the Indian population. The State is endowed with 7.5 per cent of the water resource of the country and that is becoming increasingly scarce with the uncontrolled growth of population, expansion of irrigation network and developmental needs. The Bengal Delta, which was described as areas of 'excess' water in the colonial document, now suffers from acute dearth of water during lean months. The spatial and temporal variability of rain within the State causes the twin menaces of flood and drought. Both the flood and drought isopleths are expanding with time in spite of ever-increasing investment in water management. The navigation even in the southern tidal regime has become an extremely difficult task for the country boats that require minimum draft. The Kolkata port continues to face the brunt of siltation even after the artificial induction of water from the Farakka Barrage. The rivers flowing through this State have altered their courses appreciably during last two centuries and many of them have been wiped out from the map. The decades of 1950 and 1960 witnessed large scale dam-building either beyond the western border of the State or just along the boundary and even today we have no sustainable system to conserve the rain-water that falls within the geographical territory of West Bengal. The massive capital-intensive engineering interventions into the fluvial system during the post-independence era was guided by a reductionist engineering logic of remaking the Nature for meeting increasing and indiscriminate needs of population and economy. The engineers denied the basic ecological tenets and laws governing the fluvial regime and consequently the projects have not fared well in delivering due benefits and have instead been subject to serious and prolonged controversy over grim social, economic and environmental repercussions. Since 1970 there was the beginning of over-exploitation of the ground water often beyond the naturally replenishable limit. This was directly related to the introduction of high-yielding but water-intensive seeds that replaced the traditional ones. Now more than 0.60 millions of shallow and more than 5000 deep tube wells are operating in the agricultural fields of the State. The obvious impact of this ruthless exploitation of ground water is not only the growing arsenic and fluoride contamination in nine southern districts where 40 million people are directly or indirectly in peril but also the gradual diminution of water or base flow in rivers especially during lean months. (See Table 1)

The ever increasing dependence on ground water for irrigation and drinking led to the decay and abandonment of age-old surface water management system of Bengal. The *Zamidars*, especially in western *Rarh* tract excavated many ponds or built check dams to conserve the rainwater during monsoon months. The defection of this eco-friendly system began with the expansion of arable land, depletion of forest cover and expansion of railways. The hydrological equilibrium of the Bengal delta was largely impaired during 18th and 19th Century when the Zamindars and colonial rulers

Table - 1
Ground Water exploitation

Comparison of figures of 1st.,2nd., & 3rd. minor Irrigation census.										
Sl. no.	Type	No. of Schemes			CCA in ha.			GCA in ha.		
		1986-1987	1994-1995	2000-2001	1986-1987	1994-1995	2000-2001	1986-1987	1994-1995	2000-2001
1.	DW	63387	55983	39387	31984	24386	27961	44054	39879	45411
2.	STW	368316	504638	603667	624507	1015476	1169906	994475	1543586	2002210
3.	DTW	3122	4039	5139	121689	154065	183162	197650	258192	308731
4.	SF	70820	66454	53781	357212	381412	329399	427724	459040	470680
5.	SL	205471	83645	107595	545654	352936	385431	695186	496682	600161
	Total	**711116**	**714759**	**809559**	**1681046**	**1928275**	**2095849**	**2359089**	**2797379**	**3427193**

Note: CCA- Culturable Command Area. GCA- Gross Irrigation Potential Created. DW-Dug-well, STW-Shallow Tubewell, DTW- Deep Tubewell, SF-Surface Flow Scheme, SL-Surface Lift Scheme. (*Source: Report of the Third Minor Irrigation Census(2003), Govt. of west Bengal.*)

started to construct linear embankments along the bank of deltaic rivers with a view to control flood. This was a direct intervention into the fluvial regime that interrupted the annual distribution of sediment over the flood plain. The philosophy of water management was guided by a reductionist and rather simplified notion of achieving total freedom from flood by channelising the monsoon flow within embankments. This concept fails to take cognisance of the natural ecological functions that are equally important for the maintenance of the ecology and economy of the floodplains. The fluvial system continuously transfers fluid and solids and this function is not only restricted within its channel but covers the wide floodplain where silt is deposited during the annual floods. The monsoon freshet flushes out sediment load from the channel and spills over the adjoining plain. The delta or floodplain building is thus intimately related to this ecological function of distribution of sediment load over the floodplains. The jacketing of the river with embankment interrupts the vital exchange of water and sediments between the channel and the floodplain, ultimately leading to the decay of drainage channel. So embankments were rightly judged as satanic chains by Willcocks (1930) . Majumdar (1941) was more critical about this scientifically unapt way of achieving freedom from flood and wisely opined “ *...construction of flood control embankments a flood-controlling measure would be like mortgaging the future generations to derive some temporary benefits for the present generations.”* .But the State Irrigation Department chooses to remain in dark and continues to be guided by the colonial legacy of arresting the dynamic equilibrium of tropical monsoon rivers and ultimately causing degeneration of the drainage system.

The Ganga divides the State of West Bengal in to two unequal halves, popularly known as the North and South Bengal. The former is constituted of six districts namely Cochbihar, Jalpaiguri, Darjeeling, Uttar Dinajpur, Dakshin Dinajpur and Malda. These districts cover together an area of about 21763 sq. kms, which are about 25 per cent of the total geographical area of West Bengal. The population living in this geographical unit is estimated to be 15 million (2000) .The floods in North Bengal districts is almost a yearly event. This hydrological phenomenon frequently threatens lives and livelihood of a large number of people. The damages ensuing to annual flood ravages are spiraling up, year to year in spite of the ever-expanding expenditure for flood control. Even after five long decades of independence, no holistic flood management has been adopted. The Government's attitude remains inclined toward a purely engineering-oriented measure characterised by a high degree of adhocism. The official data on flood are generally full of discrepancies, unreliability and lackadaisical disinformation.

The north Bengal plain offers natural outlet to the huge rain and snowmelt water of the Ganga-Brahmaputra basin, which encompasses an area of about 1.50 million square km. The Himalayan rivers become abruptly sluggish while approaching the plains. The rivers, which were enclosed within high bank or natural levees, enjoy the opportunity of free swing. The sudden loss of energy due to declining slope compels the rivers to deposit the sediments within their bed and thereby cause reduction of the capacity of rivers to hold water. The massive landslide and slope failures in the Himalaya often create temporary dams, which block the course of the rivers. Water continues to accumulate behind the natural dam until it is overtopped or breached when huge water rushes downstream and causes total devastation. In October 1968, Tista breached a series of such debris-dams and flooded the Jalpaiguri town. Being located along foot of the fragile Himalayan range, the North Bengal plain has become extremely flood prone.

Water Resource: Availability Vs Requirement

The Irrigation and Waterways Department (1987) of the Government of West Bengal made an assessment of the available water resource within the State in 1987. The Expert committee made a detailed exploration in the 26 river basins and stated that though the surface water in this state is estimated to be 13.29 Mham, only about 40 percent of it is utilisable. On the other hand, the available ground water though being 1.46 Mham only, is totally utilisable. The Central Ground Water Board estimated the annual available ground water as1.76 m.ham while the Irrigation Commission of Government of India put it as 2.38 m.ham. (Goswami, 1995, 2002). Goswami and Basu (1992) however, presented a more detailed account of the Water Resources of West Bengal and this is the most widely accepted report on the issue. The availability of water resource within this State is spatially and temporally uneven. The one-dimensional supply-side management of water involving an almost blind faith on large dams and long distance transfer of water proved futile due to evaporation and transit losses. The water efficiency in dam-canal networks of India was estimated to be 30-40 per cent only (NCIWRD, 1999). The ever-increasing exploitation of ground water has already brought forth the problem of arsenic poisoning in 67 administrative blocks where occurrence of arsenic beyond permissible limit (i.e. more than 0.05 to 3.24mg/l) in ground water are mostly confined to shallow aquifer zones within 20-100 feet below ground level. The ground water in Nalhati and Rampurhat blocks of Birbhum district, on the other hand, was found contaminated with fluoride. While the maximum permissible limit of fluoride in ground water is recommended to be 1.50mg/l, water quality in large parts of Birbhum is reportedly alarming (CGWB, 2001). In fact present water crisis in West Bengal is largely due to misuse or abuse of water. The greatest foul is being played in the agricultural sector - the largest consumer, since the introduction of high yielding paddy in early 1970s. To realise this, one must have a comprehensive understanding about the supply-demand scenario of water in this State.

Table - 2

Availability of Water in West Bengal

Surface and Ground water (Mham)	**Availability**	**Utilisable**
Surface water	13.29	5.31
Ground water	1.46	1.46
Total	**14.75**	**6.77**

Source: State Irrigation Department

The utilisable surface water (5.31Mham) in this State is less than 40 per cent of the available surface water (13.29 Mham). One major challenge of water management is to reduce this crucial gap. If utilisable water can be enhanced to 60 per cent of the available water by creation of more storage, additional 1.20 Mham of water will be available for our use. The irrigation sector is the largest consumer of water followed by the inland navigation sector. The official projection evinces that demand of water for agriculture would shoot up to 7.71 and 10.98 Mham in the years 2011 and 2025 respectively and those are more than available water for use by all sectors. So creation of additional storage and demand side management are dual challenges of present water management.

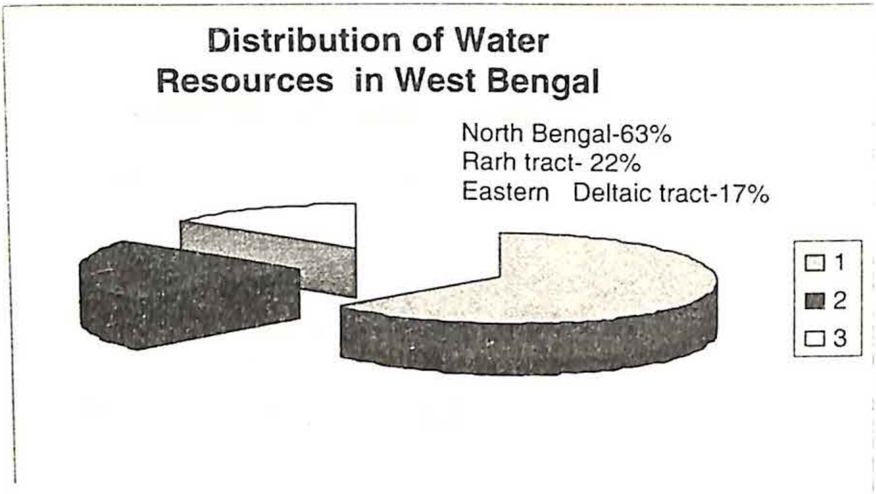
Table – 3

Requirement of Water in West Bengal (Mham)

Sector	**2000**	**2011**	**2025**
Agriculture	5.38	7.71	10.98
Domestic	0.26	0.28	0.38
Industry	0.26	0.38	0.59
Power (Thermal)	0.31	--	--
Inland Navigation	3.63	3.63	3.63
Forestry	0.01	0.01	0.01
Ecology, Environment and Others	1.00	1.00	1.00
Total (Mham)	**10.85**	**13.02**	**16.60**

Source: State Irrigation Department

The State can distinctly be divided into three geographical units viz. - North Bengal, Western Rarh and Plains to the east of Bhagirathi. About 63 per cent of the water resource of the entire State is carried by eight basins of North Bengal while the Rarh and eastern plains are endowed each with 22 per cent and 15 per cent of water respectively.



The eight river basins of North Bengal drain the southern slope of the Himalaya and carry about 98679 mcm of surface and 9130 of ground water annually. Monsoon rain is the source of most of the water in the rivers, which is concentrated within three months. The conservation or storage of water in this tract is difficult because the upper catchment of most of the rivers lie in Sikkim or Bhutan beyond the territorial boundary of West Bengal. The potential risk of siesmicity in the Himalayan terrain and high sediment load in rivers make building of dams ecologically as well as economically unsound. In fact, the huge water resource of North Bengal enters Bangladesh without being intercepted. However, there exists ample scope of rainwater harvesting but no such project has yet been undertaken. The discharge hydrographs of the rivers in North Bengal are so skewed temporally, that flood becomes a recurring phenomenon.

The reservoirs of south Bengal are located either along the western border of the State or beyond that i.e. within the territory of the adjacent State of Jharkhand. The reservoirs of Damodar Valley Corporation (DVC), Massanjore, Hinglow and Kanshabati have lost their live storage capacity substantially due to siltation. The transit loss of water during the long distance transfer of water may be more than 60 per cent in addition to evaporation loss. Thus the large dams can only effectively meet merely 2.44 per cent **of the** demand of water in the agricultural sector (see Box 1).

Box - 1

Role of Large Dams in West Bengal

Total Storage Capacity at initial stage: 413.91 X 10^7 cu.m.

Present Storage Capacity after 20 per cent reduction of capacity due to siltation: 313.13 X 10^7 cu.m.

Available water after evaporation and transit loss of about 60 per cent: 132.45 X 10^7 cubic metre.

Present annual demand for irrigation: 5380 X 10^7 cu.m.

The reservoirs meet only 2.44 per cent of the demand.

Since the supply of water is naturally constrained and demand is increasing in leaps and bounds, the gap in between is extending with time.

Table - 4

Growth of Population and Declining Per Capita Water

YEAR	POPULATION (in Crore)	PER CAPITA WATER (in cu.m)
1951	2.63	2574
1961	3.49	1940
1971	4.43	1528
1981	5.46	1240
1991	6.80	996
2001	8.02	844
2011	9.40	720

Table – 5

Water Requirement Vs Supply.

Year	Water Requirement (Mham)	Deficit
2000	10.85	38%
2011	13.02	48%
2025	16.60	59%

Source: Compiled from data of State Irrigation Department

Table - 6

Water Requirement for Some Major Crops in West Bengal

Crop	Sowing Season	Harvesting season	Water-Requirement excluding utilisable rainfall. (in mm)	Area under cultivation. ('000ha.)	Water Utilized (m.ha.m.)	Yield Kg/ha.	Production (in '000 tonnes)	Water-Intensity Litre/kg
Aus	April	August-October	300-450	402.55	0.15	2091	841.83	2152
Aman	Mid June -Mid July	November-December	300-600	4211.56	1.90	2374	9999.96	4423
Boro	December	April-May	1400-1600	1454.99	2.18	3334	4418.88	4944
Wheat	November	March	400-450	434.00	0.18	2215	961.53	1919
Potato	November	February-March	400-450	299.82	0.13	26090	7822.36	164
Jute	April	August-October	200	651.81	0.13	13556	8836.17	295
Pulses								

Oilseed	November	February	250-300	604.15	0.17	816	493.04	3370
TOTAL					4.84			

NB: 1. Aus, Aman and Boro are three types of Paddy grown in West Bengal.

2. Total water Requirement of Aus, Aman and Jute including utilisable rain water being 450, 900-1200 and 350-450 mm respectively.

Table - 7

Approximate range of seasonal ET crop in mm.

	Crop	Seasonal ETcrop in mm		Crop	Seasonal ETcrop in mm
1	Barley	300	11	Sugarcane	1000 – 1500
2	Maize	400 - 750	12	Tomato	300 - 600
3	Jowar(Sorghum)	300 - 500	13	Cabbage	250 - 500
4	Bajra(Pearl Millet)	300 - 500	14	Cauliflower	250 - 500
5	Ragi(Finger Millet))	300 - 500	15	Peas	150
6	Millet		16	Brinjal	250 - 500
7	Rapeseed	300 - 600	17	Onion	350 - 600
8	Mustard	300 - 600	18	Lady's finger	250 - 500
9	Linseed	300 - 600	19	Radish	250 - 500
10	Tea		20	Other Vegetables	250 – 500

Source: FAO Irrigation and Drainage Paper 24,(revised in 1977) and .Michael,
A.M.(1996) , Irrigation Theory and Practice, Vikash Publishing House,

Note: The ETcrop figures in mm furnish the range of actual water requirements of different crops. As is well understood the ETcrop i.e. the evapotranspiration or consumptive use of a crop depends on climatic as well as crop characteristics and hence the wide range of the value.

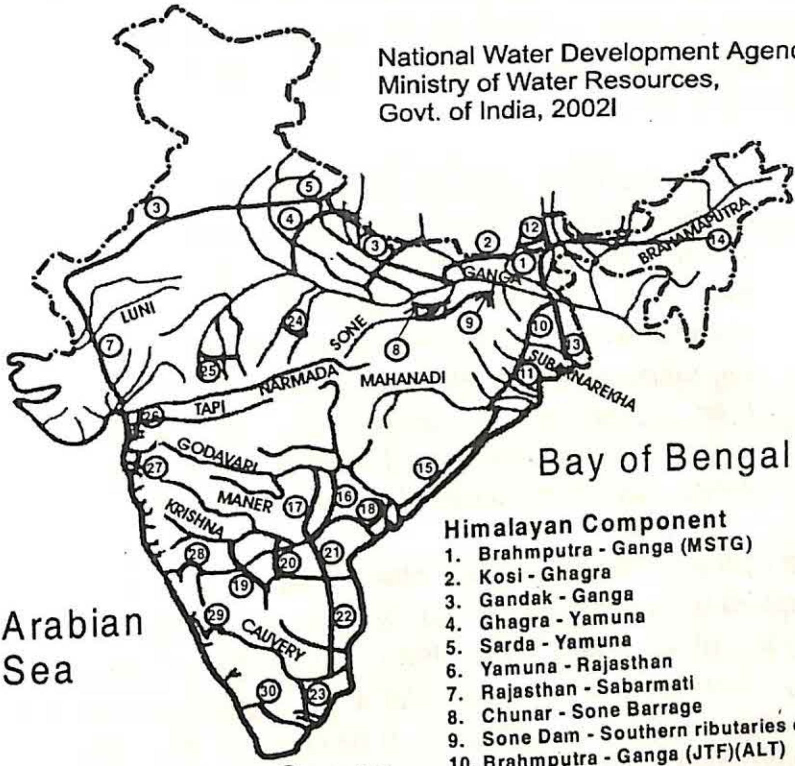
Agriculture is the largest consumer of water. If we continue in the business as usual mode, by pursuing the present irrigation type and choice of crops, the demand of water will exceed the available water in no distant period.

Proposed Interlinking of Rivers

The National water Policy was adopted on the 1st.April, 2002. The new policy proposed to divide the country into several water-zones with a view to transferring water from so called excess to deficit areas (NWP, 2002). The concept is launched with the pious intension of ensuring food security of the country.But there is enough scope to challenge the scientific validity of the project (Bandyopadhyay and Perveen,2004).The concept of excess or deficit in the ecosystem is an unmixed myth since all components are perfectly balanced in Nature. The Government of India does not take into account the basic ecological principle and ventures to withdraw a substantial portion of water from Brahmaputra-Ganga and Mahanadi basins. The excavation of 192 km.long Manas-Sankosh-Teesta-Ganga (MSTG) link will lead to the destruction of 2133 ha.of forest area in addition to 2194 ha.of agricultural land, settlement area and tea estate. The 394 km long Ganga-Damodar- Subarnarekha (GDS) link canal will gobble 8300 ha.of fertile land and forest cover (Sarkar,2004).

The project does not take into account the ecological security and the delicate hydrological balance of the Ganga-Brahmaputra delta. Nor any heed was paid to the demand of huge population living in largest delta of the World. Even the question of Indo-Bangaldesh relationship over the sharing of

Proposed Inter Basin Water Transfer Links



National Water Development Agency,
Ministry of Water Resources,
Govt. of India, 2002I

Himalayan Component

1. Brahmputra - Ganga (MSTG)
2. Kosi - Ghagra
3. Gandak - Ganga
4. Ghagra - Yamuna
5. Sarda - Yamuna
6. Yamuna - Rajasthan
7. Rajasthan - Sabarmati
8. Chunar - Sone Barrage
9. Sone Dam - Southern ributaries of Ganga
10. Brahmputra - Ganga (JTF)(ALT)
11. Kosi - Mechi
12. Farakka - Sunderbans
13. Ganga - Damodar - Subernrekha
14. Subernrekha - Mahanadi

Peninsular Component

15. Mahanadi (Manibhadra)- Godavari (Dowlaiswaram)
16. Godavari (Inchampalli Low Dam) - Krishna (Nagarjunsagar Tail Pond)
17. Godavari (Inchampalli) - Krishna (Nagarjunsagar)
18. Godavari (Polavaram) - Krishna (Vijaywada)
19. Krishna (Almatti) - Pennar
20. Krishna (Srisilam) - Pennar
21. Krishna (Nagarjunsagar) - Pennar (Somasila)
22. Pennar (Somasila) - Cauvery (Grand Anicut)
23. Cauvery (Kattalai) - Vaigai - Gundar
24. Ken - Betwa
25. Parbati - Kalisindh - Chambal
26. Par - Tapi - Narmada
27. Damanganga - Pinjal
28. Bedti - Varda
29. Netravati - Hemavati
30. Pamba - Achankovil - Vaippar

Source : The Hindu

water of Ganga, Brahmaputra and Tista was denied. Since 54 rivers are trans-boundary in nature and flows into Bangladesh from West Bengal, the Government of India should cohere with our neighboring State on the issue of water management. We may here refer to the Principle 2 of Rio declaration adopted in 1992.

> *"States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."*

The hydraulic regimes of the different basins would be largely modified by imposing structural barriers across the rivers. The withdrawal of sweet water from Ganga-Brahmaputra basin may allow the saline water wedge to ingress further inland causing a serious ecological imbalance in the delta. Still Government of India adheres to the most expensive and optimistic water-management project the human civilization has ever witnessed. The long distance transfer of water would need to negotiate the topographic barriers and the power required for the purpose may be more than the project is expected to generate.

It is learnt from the experience of large dam projects that the crucial gap between storage and actually utilised water must be reduced by shifting the place of conservation within or near the agricultural field. The only option to achieve this target is decentralised rainwater harvesting which can be attained by community participation and with the aid of low capital investment ventures. Such bottom-up options would be farmer-centered, eco-friendly and cost-effective. The major shift of paradigm should be reduction of over-dependence on ground water and that is to be utilised within the rechargeable limit. The water-intensive crops are to be replaced with drought-resistant crops as far as practicable. Finally, the community should continue to be the custodian of water. Any attempt to make the water a saleable commodity must be prevented from all corners.

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References

1. Agarwal, A. Narain, S. and Khurana, I. (2001): Making Water Everybody's Business. Centre for Science and Environment, New Delhi.pp.i-xxxi
2. Agarwal, A. and Narain, S. (1996): Flood, Flood plains and Environmental Myths. Centre for Science and Environment, New Delhi. pp 95-125.
3. Bandyopadhyay, J. and Perveen, S. (2004): Interlinking of Rivers in India: Assessing the Justifications. In Interlinking of Rivers in India: Myths and Reality. Ed. By S.K. Bhattacharya, A. Biswas and K. Rudra. The Institution of Engineers (India), West Bengal State Centre.pp.8-38.
4. Barlow, M and Clarke,T (2003): Blue Gold. Left world Books, New Delhi,pp.3-49.
5. (CGWB, 2001).Ground Water Year Book of West Bengal(1999-2000).pp.11-12
6. Gleick, P.H. (1993). Water in Crisis.OUP, New York pp.3-10

7. Goswami, A.B. (2002) Hydrological Status of West Bengal. In Changing Environmental Scenario of the Indian Subcontinent. Ed. By S.R. Basu.ACB Publication, Kolkata. pp.299-314).
8. Goswami,A.B (1995): A Critical Study of Water Resources of West Bengal. Unpublished Ph.D.. thesis,Jadavpur University,pp.57-65
9. Goswami,A.B. and Basu,B. (1992): Water Resources of West Bengal. School of Water Resource Engineering, Jadavpur University.pp.1-49.
10. I W D, G.o W. B. (1987): Report of Expert Committee on Irrigation.pp.1-27
11. NCIWRD,Govt. of India (1999): Integrated Water resource Development / A Plan for Action .New Delhi.pp. i-xvii
12. NCIWRD,Govt. of India (1999): Integrated Water resource Development / A Plan for Action .New Delhi.p.33
13. NWP,(2002): GoI, , 18p.
14. Majumdar, S.C. Rivers of Bengal (1941) Reprinted by West Bengal state Gazetteers Department. p. 19.
15. Mishra, D.K.(2002): Living with the Politics of Floods. Peoples' Science Institute, Dehradun.pp.35-68
16. Rudra, K. (2004): The Interlinking of Rivers: A Misconceived Plan of Water Management in India. In River Linking: A Millennium Folly? Ed. By Medha Patkar, Published by NAPM and Initiative. Mumbai, pp.55-70
17. Sarkar, B.(2004): Interlinking of Rivers in India- A Brief Review. In Interlinking of Rivers in India: Myths and Reality. Ed. By S.K. Bhattacharya, A. Biswas and K. Rudra. The Institution of Engineers (India), West Bengal State Centre.pp.117-124.
18. Shiva, V. (2002); Water Wars: Privatisation, Pollution and Profit. IRP, New Delhi.159p.

19. Shiva, V. Bhar,R. H. Jafri, A.H. Jalees, K. (2002): Corporate Hijack of Water. Navadanya, New Delhi. P.3.
20. Willcocks, W. (1930) Ancient System of Irrigation in Bengal Reprinted by West Bengal state Gazetteers Department. p129-30.

Rainwater Harvesting – An Alternative Source of Water

Subir Mitra

Introduction

Water is the life-blood of the environment; without water no living being can survive; water plays a unique role in the traditional economy and culture of the native peoples. Availability of adequate and usable water supply underpins our economy; water is used for power generation, waste disposal, recreation, agriculture, and various other sectors.

A sufficient, clean drinking water supply is essential to life. Millions of people throughout the world still do not have access to this basic necessity. After decades of work by governments and organizations to bring potable water to the poorer people of the world, the situation is still dire. The reasons are many and varied but generally speaking, the poor of the world cannot afford the capital intensive and technically complex conventional water supply systems which are widely promoted by governments and agencies throughout the world. **Rainwater harvesting** is an option that has been increasingly adopted in many areas of the world where conventional water supply systems falls short of peoples needs. It is a technique that has been used since antiquity.

Historical Background

Rainwater harvesting does not constitute a new technology. It is rather an old technology gaining popularity in a new way. Rainwater harvesting is enjoying a renaissance and is gaining popularity in modern days through out the world, but it traces its history to biblical times. Extensive rainwater harvesting apparatus existed 4000 years ago in the Palestine and Greece. In ancient Rome, residences were built with individual cisterns and paved courtyards to capture rainwater to augment water from city's aqueducts.

In ancient days Indians also knew the methods of conservation of rainwater. There are evidences that, even during Harappan period, there was very good system of water management. The traditional Indian rainwater harvesting practices, which are still prevalent in rural areas, were done in surface storage bodies like lakes, ponds, irrigation tanks, temple tanks etc. There are plenty of examples of indigenous system of rainwater harvesting particularly in rural India. The villagers of the Thar Desert had evolved an indigenous system of rainwater harvesting known as *kunds* (also called *kundis*). Kund is a type of covered underground tank developed primarily for tackling drinking water problems. In Meghalaya, an ingenious system of tapping of stream and springwater by using bamboo pipes to irrigate plantations is widely prevalent.

Water Crisis

About 70 per cent of the our earth is comprised of water. Yet 2.5 per cent of the world's water is fresh, of which only 0.3 percent is accessible to us from rivers, lakes and reservoirs.

The rest is stored in the most unreachable parts like glaciers, ice sheets and mountain areas. This explains the meager availability of freshwater in relation to the burgeoning demand caused by huge population growth. Thus the emergence of a severe crisis is apprehended globally.

Nearly 1.4 billion of the world's population lives in regions that would face severe water shortages in the first quarter of the new millennium. 'These regions do not have sufficient water resources to maintain accepted levels of food production from irrigated agriculture and also do not meet reasonable water needs for domestic, industrial, and environmental purposes,' said the IWMI (International Water Management Institute) in a study completed in 1998.

Further, according to the UNEP (United Nations Environment Programme), more than 2000 million people would live under conditions of high water stress by the year 2050 and water could prove to be a limiting factor for development in a number of regions in the world. About one-fifth of the world's population lacks access to safe drinking water and with the present consumption patterns, two out of every three persons on the earth would live in water-stressed conditions by 2025. Around one-third of the world population now lives in countries with moderate to high water stress, where water consumption is more than 10% of the renewable fresh water supply, said the GEO (Global Environment Outlook) 2000, the UNEP's millennium report. Pollution and scarcity of water resources and climate change would be the major emerging issues in the next century, said the report.

Water Conservation and Non-conventional Source

The United Nations Environmental Porgramme (UNEP) has listed Kolkata as one of the 12 megacities dependent mostly on groundwater, although in terms of water availability, the city of Kolkata, and even West Bengal at large, is in a better situation compared to other places in India. The dependence on groundwater is even greater in the rural areas of the state, with about 80 per cent of drinking water and 50 per cent of water used for irrigation, being accessed from underground through a network of three million hand-pumped wells. But, several areas of the state are arsenic affected. Hence conservation of water resources is what is needed.

The fundamental reason for conservation of water is the dearth of water due to unplanned and uncontrolled extraction of groundwater, which disturbs the hydrological balance leading to decline in the productivity of wells, rise in energy requirement and deterioration in quality of water. Thus the judicious use and conservation of water is of prime importance. However, wise use is not only just learning to save water, but also not to waste it. So, an excellent option left for us is not to waste rainwater, but to collect it where it falls and thereby, conserve water in a scientific manner for its gainful use.

Over-exploitation of natural resources and its resultant stress on the environmental is evident all over. Pollution of aquatic environment due to human activities has nearly destroyed aquatic and posed a serious threat to human health. Gross misuse of water resources has caused widespread degradation of soils, disrupted the supply of potable water, and generated massive economic losses.

High density developments have a big impact on municipal water sources and aquifers. Clean water is now a precious commodity in todays society. Rainwater harvesting is a simple technology that can make a big difference in water conservation. Rainwater harvesting techniques can provide a free, higher-quality non-conventional source once the initial investment in collection and storage systems is recouped.

Rainwater Harvesting

For centuries, people have relied on rainwater harvesting for household, landscape, livestock, and agricultural uses. Before large, centralized water supply systems were developed, rainwater was collected from a variety of surfaces – most commonly roofs – and stored on site in tanks, known as cistern. With the advent of large, reliable community treatment and distribution systems and more affordable well drilling equipment, rain harvesting systems have been all but forgotten, even though it offers a source of very good quality of water. A renewed interest in this time-honoured approach has emerged due to :

- Escalating environmental and economic costs of providing water by centralized water systems
- Health concerns regarding the use of polluted water-bodies as source of water abstraction, inadequate water treatment and contamination in the distribution pipeline network.

The modern methods of rainwater harvesting can be broadly categorised under two – (a) collection and storage of rainwater for direct use, and (b) ground water recharging. A combination of these two are also practiced, where rainwater is collected and stored in containers for direct use while the collected rainwater in excess of the storage capacity is charged into ground (ground water recharging).

Rainwater harvesting is a very simple method, and does not require much of scientific knowledge and technical expertise. The underlying principal of the rainwater harvesting is very simple – 'collect the rainwater when it rains and don't allow rainwater to run away' (runoff). It requires simple arrangements for collection (usually through gutters and dropdown pipelines) of rainwater falling on rooftop and storage of collected rainwater for direct use and/or for groundwater recharge. This method is commonly known as **Rooftop Rainwater Harvesting**. Rainwater falling on the open spaces around the building (other than rooftop) is also used for rainwater harvesting generally by means of groundwater recharging. In urban areas, rooftop rainwater harvesting has gained popularity for its convenience and less reqirements of space for collection and recharge systems.

In rural areas, surface spreading techniques are common since space for such systems is available in plenty and quantity of recharge water is also large. Following techniques are adopted to save water going waste through slopes, rivers, rivulets and nalas – (a) rainwater harvesting through gully plugs, (b) rainwater harvesting through counter bunds, (c) rainwater harvesting through gabion structure, (d) rainwater harvesting through percolation tank, (e) rainwater harvesting through check dams/cement plugs/nala bunds, (f) rainwater harvesting through recharge shaft, (g) rainwater harvesting through dugwell recharge, and groundwater dams, or sub-surface dykes.

While large sophisticated systems are not cheap, individual citizens can device and use their own rooftop rainwater harvesting system that is effective and affordable. Rainwater catchment system provide a source of soft, high quality water, reduce reliance on wells and other water sources, and in many context are cost-effective. Systems can range in size from a simple rain barrel to a more technically sound designed and built system. However, rainwater harvesting systems are inherently simple in form, and can often be assembled with readily available materials by owner-builders with a basic understanding of plumbing and construction skills.

Advantages Of Rainwater

The Never-ending Water Cycle : The never-ending exchange of water from the atmosphere to the oceans and back again is known as the hydrologic cycle. This cycle is the source of all forms of precipitation (hail, rain, sleet, and snow), and thus of all water. Precipitation stored in streams, lakes, and soil evaporates while water stored in plants transpired to form clouds, which store the water in the atmosphere.

Environmental Advantages : Collecting the rain that falls on a building to be used nearby is a simple concept. Since the rain harvested is independent of any centralized system it promotes self-sufficiency and helps to foster an appreciation for this essential and precious resource. Collecting rainwater is not only water conserving, it is also energy conserving since the energy input required to operate a centralized water system designed to treat and pump water over a vast service area is bypassed. Rainwater harvesting also lessens local erosion and flooding caused by runoff from impervious cover such as pavement and roofs, as some rain is instead captured and stored. Thus stormwater run-off, the normal consequence of rainfall which picks up contaminants and degrades our waterways, is avoided to a great extent and the captured rainfall can be utilized in gainful ways.

Qualitative Advantages : The major advantage of rainwater over other water sources is that, it is one of the purest source of water available. Indeed, the quality of rainwater is an overriding incentive for people to choose rainwater as their primary water source. Rainwater quality almost always exceeds that of ground or surface waters : it does not contain salts and minerals, and it is not subjected to many of the pollutants that often are discharged into surface waters such as rivers, and which can contaminate groundwater. However, rainwater quality can be influenced by region where it falls, since localized industrial emissions affect its purity. Thus, rainwater falling in non-industrialized areas can be superior to that in cities and towns dominated by heavy industry and automobiles. Depending on where the rainwater harvesting system is located, the quality or rainwater itself can vary, reflecting exposure to air pollution caused by industries and high concentration of automobile emissions.

Rainwater is soft and can significantly reduce the quantity of detergents and soaps needed for cleaning. Additionally, need for a water softener, often an expensive requirement for well water systems, is eliminated. Water heaters and pipes remain free of deposits caused by hard water and therefore, last longer. Rainwater's purity also makes it an attractive water source for certain industries requiring good quality of water.

Water Quality Considerations

Once rain comes in contact with collection surfaces, it can wash many types of bacteria, molds, algae, protozoa and other contaminants into the cistern or storage tank. If the rainwater is intended for use inside the household, either for potable uses such as drinking and cooking or for non-potable uses including showering and toilet flushing, appropriate filtration and disinfection practices are required to be employed. If the rainwater is to be used outside for landscape irrigation, where human consumption of the untreated water is less likely, the presence of contaminants is not supposed to be of major concern and thus treatment requirements can be less stringent or not required at all.

The pH of rainfall is supposed to be 7.0, if there were nothing else in the air. However, as rain falls through the air, it dissolves carbon dioxide that is naturally present in the air and becomes slightly acidic. Any sulfates or nitrates dissolved from the air will also lower the pH. The resultant pH of rainwater becomes slightly lower than the neutral – around 6. Although the pH of rain is below neutral, it is only slightly acidic, and its neutralize very easy.

Rainwater proves to be of better quality than well or municipal tap water from aesthetic points of view – such as color, taste and smell. Inorganic impurities such as suspended particles of sand, clay, and silt contribute to the water's colour, and smell. Proper screening and removal of sedimentation help to decrease problems caused by these impurities..

Concrete Embankment in Kolkata Water Bodies: An Ecological Problem

Kaustuv Basu

Wetlands, as the term implies, are 'Wet' lands that exist because the inflow of water exceeds the outflow for brief to extended periods of time during the growing season. They are basically the *ecotone*, that is the transitional area between two eco systems. Inland wetlands receive water from precipitation, surface overland flow, ground water discharge, lake seiches and seepage from streams, lakes, ponds and irrigation systems. Most natural wetland functions are a result of or closely related to wetland hydrology. Wetland food chain, fish and wildlife habitat value, nutrient cycling, socio-economic values, heritage and even aesthetic values are tied to the source, velocity, frequency, timing and quantity of water.

The fact that lakes occupy such a small fraction of the landscape belies their importance as environmental systems and resources for human use. They have intrinsic ecological and environmental values. Besides, humans use lakes for many commercial purposes including fishing, transportation, irrigation and industrial water supply, and lakes function as receiving waters for wastewater effluents.

Water Bodies of Kolkata

It is very controversial that in Kolkata how many water bodies really exist. An estimation of Municipal Architect and Town Planning Department of Kolkata Municipal Corporation (2003) shows the number is 3,733 in total 141 wards. In another study by Society for Environment and Development, a city-based environmental organization, total 1,177 water bodies have been surveyed out of 1,223 within ward no. 101-125. There was no trace of 46 water bodies. Green Circle of India, another city based environmental group have found 168 water bodies in ward no. 81, 89, 93-96 and 98-100 under Kolkata Municipal Corporation. It has recently been estimated that within no.10 borough under Kolkata Municipal Corporation, in 12 wards, out of all total 384 water bodies, 25.3% remain only useful while the left about 75% have been degraded. Among these degraded ones 15.4% have been turned into dry land while there are large buildings or constructions in 12.5% cases. It has been recorded that in the added area (i.e. within 101-141 wards in KMC) about 20% water bodies have already been filled up.

Degradation of Water Bodies

In the name of development and urbanization a number of thrusts fall on an urban water body. The degradation of aquatic system is a worldwide phenomenon originated from the intense population growth and from the corresponding increase in industrial activities. The need of water for human activities led to population settlements at the immediate vicinity of rivers and lakes. In a long term these water resources were degraded as a consequence of the discharge of several kinds of pollutants, mostly originating from domestic, agricultural and industrial processes. From all aspects including social, environmental, natural as well as management point of views, water bodies are prone to degrade (fig 1).

- Waste disposal
- Pollution from industries
- Eutrophication

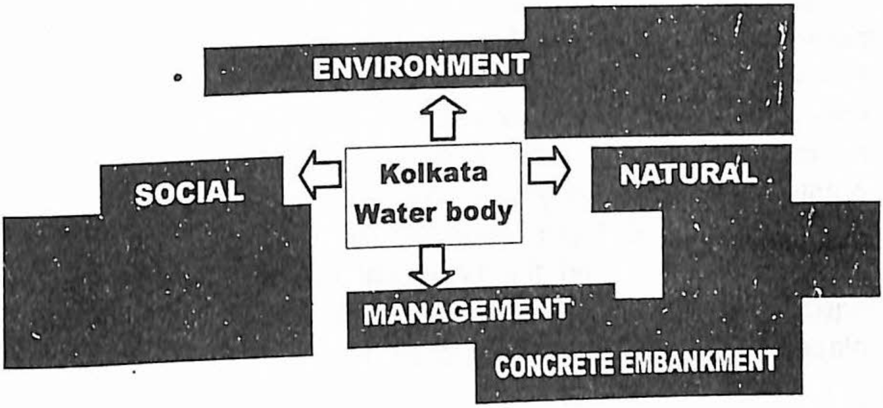


Fig 1: Thrust on Kolkata water bodies

Role of Kolkata Municipal Corporation (KMC): Concrete Embankment

In order to restore water bodies Kolkata Municipal Corporation (KMC) has taken different initiatives. The latest one is to wrap the embankment of the ponds with the cemented covering. No proper survey has yet been carried out on this issue. Still about 20% of the urban water bodies has concrete embankment.

Effect of Concrete Embankment

Due to the concrete embankment the natural balance of the water bodies is distorted. It not only makes the water bodies an artificial tank, also catalyses the loss of a number of biological species housing at the bank.

Effect on Biodiversity

The embankment-biodiversity supplies excess oxygen that reduces the degree of pollution of Nitrate and Phosphate in the aquatic system and also helps in adsorption of heavy metals. From the soil substratum the aquatic flora gets nutrients and minerals. They entrap solar energy by photosynthesis and flourish. Depending on them the aquatic fauna acquire nutrition and grow. They utilize oxygen dissolved in water. The aquatic flora and fauna maintain the balance between the dissolved oxygen and the biological oxygen demand in the aquatic ecosystem. Due to this cycling the aeration takes place in the water bodies that make them naturally purified.

Water alone is not enough to support the aquatic lives. Food must be available for them to eat so they can grow. The food supply depends on basic nutrients (organic material and minerals in the water. These nutrients stimulate microscopic plants to grow and multiply. The transfer of food energy from the producers through a series of organisms (herbivores to carnivores to decomposers) with repeated eating and being eaten is known as *food chain* (fig 2).

Unlike all ecosystems a pond bears different grazing food chains that together form *food web*. It is reported that the largest biodiversity exists at the border of the water bodies. If the embankment is wrapped in cement, the primary producers (green plants) wouldn't get space to flourish, which eventually reduces the population of the following candidates of the food web of that particular ecosystem. That is the whole eco-balance or eco-equilibrium of that water body would be distorted, which will finally lead to the death of that pond eco system (fig 3).

Effect on Hydrogeology

Concrete embankment has adverse effect on the hydrogeology. If there be any rise in ground water layer, the excess water finds no way to get out if it be cemented. Therefore the water may have pressure on the embankment which thereby can also break the embankment construction.

Alternatives of Concrete Embankment

Instead of traditional concrete embankment, following alternative approaches may be adopted (fig 4):

1. Partly concrete and partly earthen: Instead of complete cementing, the embankment may be partly concrete; in an 8 ft deep water body; the upper about 2 ft area may be cemented alternatively, so that the floral community may get space to grow in the embankment.

2. Surrounding with wooden logs: Embankment may be surrounded with wooden log that would prevent soil erosion. In Baghajatin area, in South Kolkata, 'KajiPukur Samrakshan Samity' has conserved their water body in this fashion.

3. Boulder with wooden logs: The water body may be surrounded with boulder and wooden logs both having earthen embankment. Such an instance can be viewed in case of Neel Pukur, located at Santoshpur in South Kolkata.

4. Turfing on the embankment: Instead of concrete embankment, turfing may be applied along the bank of a water body. Seeding of embankment outside the

water liner with perennial short rooted low growing grasses.

5.Increase of embankment height with soil: Increasing the embankment height with soil, the surface runoff may be prevented in the water body.

6.Sieves: Using some metallic sieves, the embankment of a water body may be protected. Hog tight fencing around the basins or site.

7.Embankment slope between 3 and 3.5 horizontal to 1 vertical.3 feet free board.

8.Embankment and upper 12" of the interior bottoms to be compacted to not less than 95% of the maximum standard proctor density, in not more than 6" uncompacted layers, at the optimum moisture to optimum moisture plus 3%.

9.The maximum rate of water loss through embankments and bottom shall not exceed ¼ inch per day. To achieve this, the basins should not be constructed in sand, gravel or other highly permeable soils, which have hydraulic permeability greater than or equal to 10^{-7} cm/second.

10.In order to protect from ground water pollution, a minimum of 10' vertical separation shall be provided between the lowest point on the bottom of the basin and the average annual elevation of the groundwater table.

Adverse Effect of Concrete Embankment : A Brief Study

To find out the detrimental effect of the concrete embankment on the water body a preliminary comparative bio monitoring study has recently (2004) been carried out in the two nearly equal sized ponds, Bibeknagar Jheel (with concrete embankment) and Neel Pukur (without concrete embankment) respectively, both located in Santoshpur in South Kolkata. The study reveals, there may be link between water quality and the embankment-biodiversity of the pond. According to the Secondary Water Quality Classification (SWQC) developed by Central Pollution Control Board (CPCB), Bibeknagar Jheel falls under D category while Neel Pukur falls under class C.

Debate: Voice Against Conventional Concrete Embankment

Mohit Ray, Secretary of Vasundhara Foundation of Kolkata first brought the issue in the public domain. The way, KIT and KMC jointly were going to protect the Rabindra Sarovar, the national lake in South Kolkata, he criticized it tremendously. He said with high perturbation," Corporation has turned the water bodies into some artificial tanks. They haven't any proper planning to restore the water bodies. They have constructed concrete embankment unscientifically." In this regard it is to be mentioned that 1/3 rd of the embankment of this sprawling water body is still covered with green grasses while the remaining part is wrapped with cement. The issue arose a wave in the Kolkatan Environmental world. Both the academicians as well as Nongovernment environmental groups have come forward against this 'Tughlakian' action of KMC. **Mukuta Mukherjee**, the Secretary of Friends of Wetlands and Wildlife, Kolkata said," Concrete embankment catalyses the loss in aquatic biodiversity." Veteran ecologist, **Prof. T.M.Das** advised," In America, in order to protect the roadside-plants, they use to put cemented or iron sieves encircling the plants leaving about 5 ft radii surrounding the soil substratum. Following the same principle we can also protect our water bodies." Eminent Environmentalist, **Prof. S.C.Santra** delivered his views against this unscientific footstep. Wetland Ecologist and Consultant, **Dr. Subir Ghosh**

said," The amount of waves that usually rise in a large about 1-1.5 bigha(s) water body is not enough to erode its surrounding embankment." He explained that in concrete embankment, the algal population especially the number of filamentous algae increases very much that eventually reduces the light penetration to the bottom surface of the water body. But a school of Environmentalists do not support this view. Renowned zoologist **Prof. N.C.Dutta** also emphasized on not to denature the natural balance of the environment. **Chiro Dutta**, Secretary of Calcutta 36 suggested that the bank might be sloped in 2:1 ratio with green turfing over it.

Side by side a group of Environmentalists do not support this 'anti-concrete movement'. **Asit Ray**, President of Green Circle of India, Kolkata, remarked," The voice is scientific but very impractical; this movement is nothing but a 'eutopic' action." Most of the politicians including mayor of KMC believe that common people would not accept this change. It would be just 'practically impossible'. For public safety embankment should be built of concrete. **Sougata Ray**, MLA, said," In virtue of public benefit, it is very difficult to remove concrete embankment."

Promises and Proposals

For about last couple of years, a group of Environmentalists have been fighting against the concrete embankment. They have already submitted written report to KMC and also to different departments of the state government like Dept. of Fisheries, Dept. of Environment etc. So far what the informations have been available, Dept. of Fisheries has done a sole study on this issue. Minister of Fisheries has already started discussion with the Environmentalists. The State Government has declared that they would settle a special committee to look after this matter.

Conclusion

The way the 'anticoncrete movement' is going on, is really appreciable. There is no doubt that concrete embankment has some deleterious effect on the health of water body especially on its biodiversity, but still no much study has been carried out in this regard. So far as I concern, only one proper scientific study has yet been done on this particular issue in Kolkata-water body which hasn't yet been published. But that study is very preliminary and a lot more scientific work is required to come in any such concrete conclusion. Further more any proper alternative should be applied which would be practically feasible and which would come in benefit of public. That is, biodiversity would be conserved in the embankment region as well as the water body should be safe to use to the common people. Finally it is very important to mention that there should be proper balance between civil engineering and Environmental Scientists in any project of Corporation. Unless the fate of that project would be as alarming as that of Adi Ganga, which has turned now just a sewerage under ongoing construction of Metro Railway. Also it would be quite beneficial for the Kolkata environment if there be proper coordination between different departments of the state government as well as between the scientists and the policy-makers. Already some affirmative action has been initiated to conserve the urban water bodies from the government level; but if it be a mass action then it would be much more fruitful.

References

1. Basu, K. 2004. Pukurer Mrityu (*Death of pond*); Prakriti-o-Manush, Kalantar. 29 March 2004. Kolkata
2. Basu, K. 2003. Concrete embankment kills the water bodies in Kolkata. Bhoomijal. 15 December 2003. New Delhi

3. Mukherjee, M. 2003. Pukurer par bandhano, Purosabhar sarbaneshe buddhi (*Concrete embankment, crazy attempt of Corporation*). Anandabazar Patrika. Kolkata
4. Santra, S.C. 2001. Environmental Science. New Central Book Agency (P) Ltd. Kolkata. pp. 52-54
5. Sharma, P.D. 2001. Ecology and Environment. Rastogi Publications. Meerut. pp. 229-230
6. Vasundhara publication. 2004."An interface on development ofVikramgarh Jheel - an issue of urban ecology and planning":

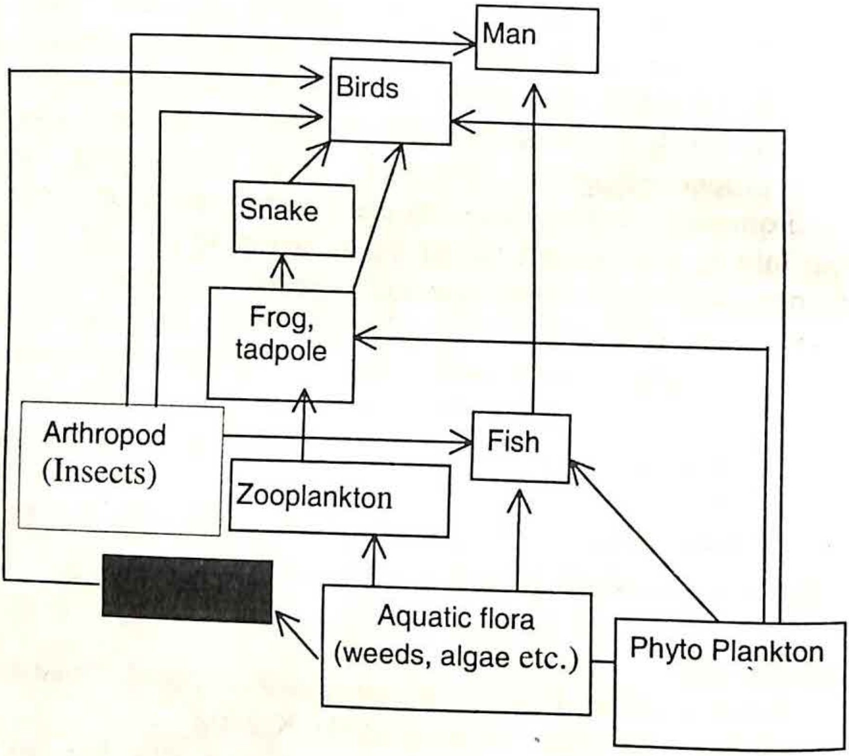


Fig 2: Normal food chain of a water body

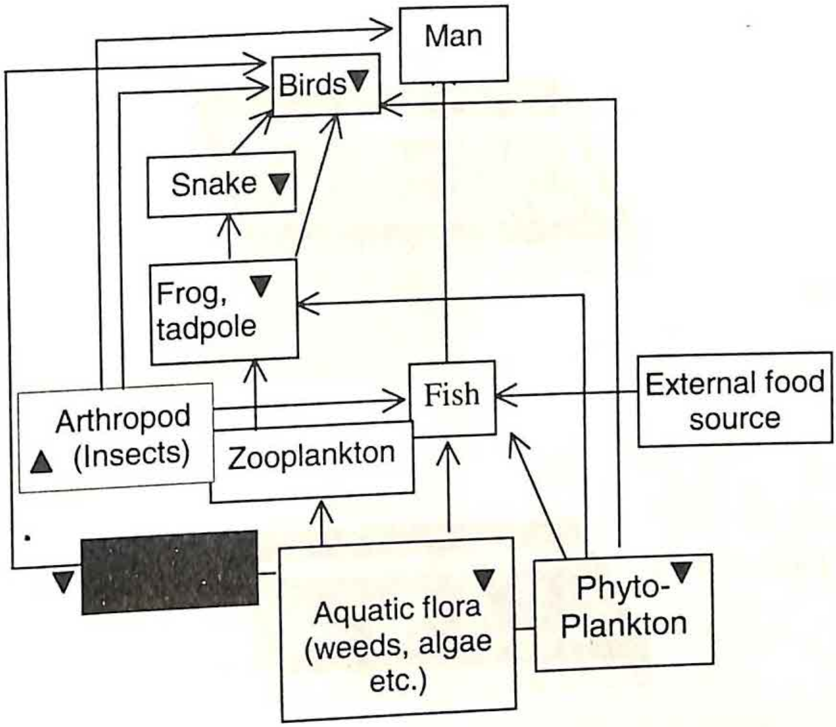
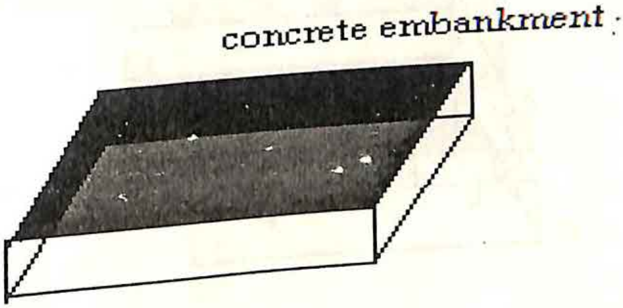


Fig 3: Affected food chain of water body with concrete embankment *(The symbol [arrow] shows increase or decrease in population)*



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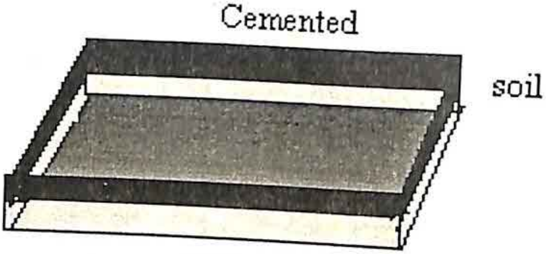

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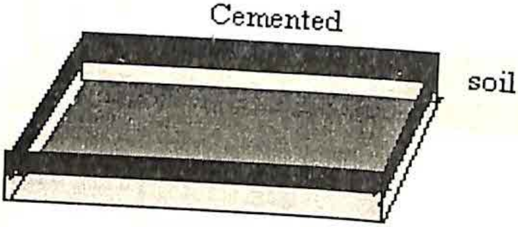

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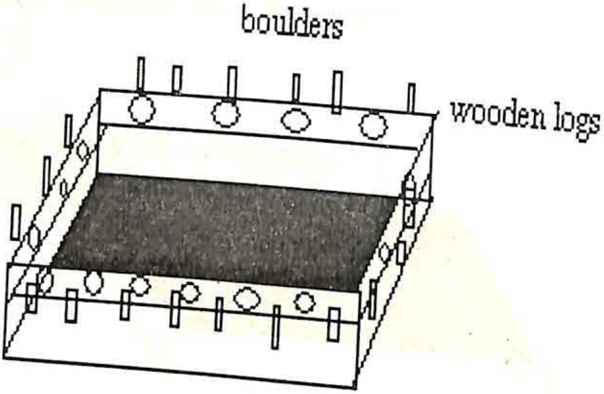

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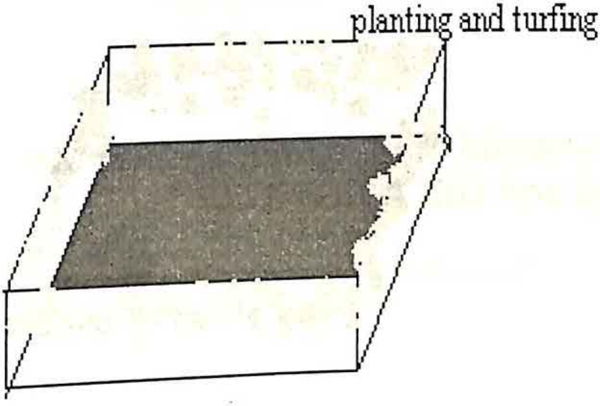

(V)

Fig 4: Alternative approaches that may be adopted instead of concrete embankment:

(i) Traditional water body with complete concrete embankment;

(ii) Partly cemented and partly with natural soil substratum;

(iii) surrounding with wooden logs;

(IV) embankment with boulders and wooden logs;

(v) embankment with turfing and plants

Environmental Management – Remote Sensing and GIS A New Tool

Parthsarathi Chakrabarti

Introduction

The historic Earth Summit June 1992 at Rio de Janeiro marks the beginning of a new era of ecological revolution. Agenda 21 identifies the need for studying and monitoring the environment and proposes –

- Improving of the efficiency of resource utilization.
- Strengthening of the scientific basis for sustainable management.
- Improving of long term scientific assessment.

In these aspects, the focal areas as identified by the Global Environment Facility (GEF) are Biodiversity, International Waters, Climate Change and Ozone layer depletion.

In this regard, the operational activities of the GEF (a collaborative venture of the World Bank, United Nations Environment Programme (UNEP and UNDP) aim towards –

- Identification of 'Disturbance Gradient' zone in the biophysical environment.
- Prioritization of 'Bioprospecting' zones for biodiversity conservations with special emphasis on

land degradation, coastal/marine, fresh water and forest ecosystems.

- Information dissemination for building public awareness in order to ensure public participation i.e. social adaptation.

Prime Requisite

Core business of environmental management vis-à-vis biodiversity conservation reflects on natural resources management in human orientation i.e. to find out the relationship between the present day landcover/landuse pattern and landscape ecology. That requires land/terrain evaluation to identify the rock/soil-water-vegetation interrelationship in the context of geo-bio-cultural interactions and to depict the same in spatial format (i.e. in the form of a map) for enhancing the visualization capacity towards individual thinking.

In the present day scenario, the Environment Mapping exemplifies the suitability of different terrain (landform) units in relation to the existing utilization or selective alternate uses.

Easy-to-understand presentation of data in 'environmental mapping' requires identification of Geo-environment unit (GEU), in relation to Natural system unit or Terrain mapping unit (cf. Fabbri & Patrono,1995)

Geo-Environmental Indicators (GEI)

'Process-sensitive and easy-to-measure' physico-chemical characteristics of dynamic earth which help in identifying the various geomorphic environment in human orientation through space and time (cf. Cavallin et.al, 1995). GEI may be of two types – Qualitative indicators and Quantitative indicators :

Qualitative indicators allow to identify the specific characeristics of landform units(s) in terms of spatial change detection, e.g. landslide/soil erosion/flood prone areas, bankline shifting of a river or shoreline shifting etc.

A Quantitative indicator is supplementary to Qualitative indicator. In this context, numerical attributes related to change detection generated from in situ measurements are of basic importance e.g. round the year beach profiling data to specify the zone of erosion or accretion; sediment monitoring station may generate data on soil erosion; variation in chemical qualities of water in identifying the hydrological characteristics of an area.

Geo- Environmental Unit (GEU)

Spatial database with certain entity or bounds as defined by GEI. A GEU may contain one or more TMU (Meijrink, 1988) or natural system unit (NSU) and vice-versa. For example –

i) In the medinipore coastal plain, West Bengal, India erosion is present in the beach face of Digha-Shankarpur (Chandpur) sectors whereas accretioal phenomenon is observed in the same beach face of Dadanpatrabar-Junput area (Chakrabarti, 1991,1995). In both the cases, the terrain unit is 'beach face' but two GEU may be indentified depending on erosional and accretional behaviours.

ii) In western upland of West Bengal, India forest / social forestry is present in different terrain units viz. Burried pediment (shallow) and Lateritic upland (Chakrabarti et.al, 1996, 1998, 2002). In this case, with pragmatism two different terrain units may be clubbed under one GEU (e.g. 'Forest land') giving more emphasis on land cover / land use factor in comparison to other factors like degree of dissection, slope aspects etc. which may be considered for further subdivision in user orientation.

iii) In Jambudwip, (a tidal shoal in the Hooghly estuary), mangrove forest is fast deteriorating covering two TMUs (viz. Mangrove swamp and Supratidal core) due to human interactions (Chakraborti, 1991). In this case 'Mangrove forest zone' may be indentified as a GEU considering the geomorphic environment challenged by anthropogenic activities.

iv) Arsenic contamination in groundwater –Terrain analysis and classification reveal that in western part of Bhagirathi / Hooghly river (major distributary of Ganga river) arsenic toxicity in groundwater prevails in the Younger alluvial plain wheras the groundwater in the adjacent alluvial plain/fan areas of Ajoy and Damodar river are free from arsenic contamination. In geomorphological terms both are alluvial plain, however, two GEU may be identified based on the occurrence of arsenic contamination phenomenon.

v) In the Gondwana Upland two types of Coal mining activities are in operation : open cast mining and underground mining. In the context of environmental analysis three different GEU could be delineated viz. the 'disused' open cast mines, mining waste dump are areas of land subsidence though geologically / geomorphologically the area is termed as Gondwana Group / Gondwana Upland.

Appropriate Technology

Geo-informatics, operational combination of RS and GIS technologies (Chakrabarti & Nag, 2002) play facilitator role in collection as well as integration and analysis of the up-to-date spatial database with the existing data sets to generate application specific ***'strategic datasets'*** for technological adjustment (structural means) and social adaptations (non-structural means) with future perspective, towards :

- Environmentally sound landuse /landcover practices. In Indian scenario, → Agro-ecological characterization agricultural environment analysis and biodiversity conservation need special attention regarding socio-economic conditions (e.g. marginal farmers do not consider the environmental hazard created by them in the context of using pesticides etc. for their livelihood).
- Minimising the adverse effects of natural hazards (e.g. droughts, floods) land degradation etc.
- 'Easy to use" data format in digital mode to enable e-governance especially in a sector like rural poverty alleviation and food security as well as biodiversity conservation.

In the present scenario, the state-of-art technoloty of the high resolution 'operational' Earth Observing Satellites (EOS) provides multi-temporal/time critical up-to-date 'real world' features in digital mode or in hard copy format. In this respect, the RS data are playing facilitator role in collecting or detecting spatial as well as thematic aspects of the changing earth's surface.

In global scenario, presently, two Indian 'civilian satellites – IRS 1C and IRS 1D with 5.8m (PAN) and 23.5m (FCC) resolution are leading provider of satellite data for commercial uses and applications. Recent additions are IKONOS satellite, which provides image of 1m resolution in PAN mode and 4.0m resolution in FCC mode. Quick Bird with 90cm resolution in PAN mode and resource Sat 1(IRS P-6) with 5.8m resolution in multi-special mode. The microwave satellites (viz. ERS, JERS, RADARSAT etc. with all weather and all time capabilites facilitate the operational use of RS data for real-time monitoring of disaster prone areas in terms of flooding, coastal surges, landslides etc. In near future, with the introduction of 'Hyper spectral imaging' system (with more spectral bands and narrow band widths) scope of separability of different objects/ materials will be enhanced significantly (Skidmore et. al, 1997).

In response to the 'PIXEL ⇌ RASTER FORMAT' inherent relationship the RS data are being widely used in GIS (Geographic Information System) environment for integration and analysis of spatial and related non-spatial attributes as per users choice.

Rational and optimal utilization of RS and GIS for identification, integration and analysis of thematic aspects of terrain units in relation to the generated /existing numerical attributes (by insitu/conventional methods) may be considered as the most holistic approach to conclude on decision rules/noms for GEI and GEU.

Geo-Environmental Mapping : Application Field

'Technology Push' rather than 'Application pull' leads to import/ implement technology not appropriate to the social settings/matching solutions → 'Ethno-Science' to be improved by 'Techno-Science' (i.e. 'Technology Push') for more responsive landuse/ landcover practices to protect natural resources in relation to changing socio-economic environment.

Case history examples from eastern India :

- Interlinking of rivers : 'inter basin'/'intra basin transfers' – existing big dams'reservoirs to combat floods and droughts as well as to increase agricultural production – a subjective approach? In eastern India Gandak barrage, Kosi barrage, Farakka barrage exemplifies salinization, water logging, soil degradation, bank erosion, river bed level rise etc. – reflects on the change in landuse/landcover pattern through space and time. For example, the Bhutnir Char is a permanent Channel bar/River island upstream of Farakka Barrage in Maldah district, where the Ganga R. enters West Bengal from Jharkhand state. Geomorphologically, such channel bar is the river's playground during the high discharge time/during the rainy season. At that time flood water spreads over such channel bar depending on the volume of water carried by the river. By that way the channel bars become very fertile land as silt of the flood water get deposited.

But ignoring this scientific riverine phenomenon 'Circuit embankment' was constructed in 1972 with populist approach. The net effect of such construction are now being faced both by the inhabitants of the Bhutnir Char and the villages downstream of the river viz. Manikchak, Gopalpur, Panchanandapur etc. Due to the construction of the circuit embankment the river is now flowing through the constricted channel more violently during high discharge time causing bank failure in Manikchak, Gopalpr – Panchanandapur sectors.

Secondly, water logging situation prevails within the circuit embankment as rain water cannot pass easily into the river as it was possible when there was no embankment. Moreover, the silt of the flood water is not being deposited over the char land – fertility of the land is reducing gradually. Considering this burning example no such circuit embankment is to be constructed in the 'Nirmal Char' in Akheriganj, Murshidabad district, down stream of Farakka.

In this regard, it may be mentioned that the words 'inter basin'/ 'intra basin' invite special attention towards nature's own built system as a river basin/watershed is a distinct hydrological unit in the context of 'Hydrological Cycle'. Any change in water–sediment–vegetation regime of watershed due to natural or anthropogenic reasons may cause substantial changes in river morphology as well as stability of the area which in turn may badly affect the present day landuse/landcover i.e. built up land, crop land, forest etc. For example, in the later part of the 18th century (1787?), due to some geological reasons (tectonic activities coupled with landslides), the Tista river changed its course and joined Brahmaputra river instead of debouching in the Ganga river (cf. Ferguson, 1912; Roy,1952; Bhattacharyya, 1959; Chowdhury and Kamal, 1996) and the three distributaries of the Tista river viz. Punarbhava, Atrai and Karotoya rivers were not receiving any water from the Tista river as it was earlier (Chakrabarti, 2004). As a consequence, one may find shrinkages in channel width, cut off meanders/ wet lands and change in cropping pattern in the area. Historical accounts also reveal that the changing course of Kosi, Mahananda rivers in the Himalayan foot hill region of eastern India made the 'Gauda – Lakhmanbati – Pandua' kingdom uninhabited due to water logging etc. (cf. Roy, 1952).

It may be mentioned here that considering the physiographic set up of the eastern part of West Benal the 'river linking' concept is likely to be beneficial for reducing the water logging situation as well as to support the existence of certain bio-assemblages (viz. Sundari, Garan, Golpata) of the Sundarban' link (No. 12 of the Himalayan Component) of NWDA (National Water Development Authority) may be considered with some modifications through rejuvenation of the "Nadia Group of River" viz. Bhairab, Jalangi, Mathabhanga, Churni and Ichhamati rivers (Chakrabarti, 2004).

In this context programmes viz. 'Integrated Mission for Sustainable Development' (IMSD), 'Natural Resources Information System' (NRIS), of Deptt. Of Space and 'Natural Resources Development & Management System' (NRDMS). Department of Science & Technology, Govt. of India are Ideal examples.

Under these programmes 'geoinformation' in village/mouza level (i.e. the lowest administrative unit) on micro-watershed basis been generated for agro-ecological development minimizing the adverse effects of drought and flood hazards mainly through technological adjustment and social adaptations.

Pilot scale implementation of the 'generated database' (both physical and socio-economic) have proved successful in Indian scenario with agro-ecological characterization → agricultural environment analysis and biodiversity conservation, minimizing the adverse effects of natural hazards (e.g. droughts, floods) land degradation etc.

In view of that developmental planning on watershed basis may be considered as a form of maintaining the landscape ecology where a compromise is sought between the development in catchments and conservation of natural resources (both land and water resources) including biological diversity (cf. Meijerink, 1990).

However, it may be mentioned that terrain based 'area specific' intra and/or inter-basin transfer of river-water seems unavoidable to support 'watershed development' programme.

- Along the east coast of India, cultivable land /salt pans of the lower estuarine plain/coastal belt are being used for brackish water fish farming, especially, prawn cultivation (e.g. Digha Mohona;Bengal salt factory area, Dadanpatrabar, Medinipur district (E) West Bengal) – 'easy-to-fetch money' but likely to increase salinity of the surrounding fields and groundwater as well as accelerate long lasting water-logging situation during cyclone /storm upsurge.

The aforesaid discussion reflects on the necessity of the 'Geo-environmental mapping' concept as 'Application pull' rather as 'Technology push' through fine tuning of the baseline data already generated under the above mentioned programmes towards sustainable landuse planning in human orientation.

Conclusion

Geo-environmental studies being a multivariate/multiscale approach the following steps may lead to success in reality.

- Systematic identification of the TMU/NSU and GEI/GEU using RS data with ground truthing – need knowledge-based expertise.

- Selection and proper weigt input to the 'indicators' to construct index model- require basic scientific rigour.

- Appropriate integration of different parameters (both spatial and non-spatial) in GIS environment– demand trained multidisciplinary personnel in handling and processing the data.

References

1. Cavallin, A.et.at : (1995) Geomorphology and environmental impact assessment : a methodologic approach. ITC Jour. 1995-4. Pp 308-310.

2. Chakrabarti Parthasarathi (1991) : Process-Response system analysis in the macro tidal estuarine and meso tidal coastal plain of eastern India. Geol. Soc. India. Mem. No. 22. pp 165-181.
(1991) : Morphostratigraphy of coastal Quaternaries of West Bengal and Subarnarekha delta, Orissa. India Jour. East Sciences Vol.-18 Nos. 3-4 pp. 219-225
(1995): Evolutionary history of Coastal Quaternaries of Bengal plain. Proc. INSA, Part 61A. No. 5. pp. 343-354.
(1998) : Changing courses of Ganga, Ganga-Padma river System, West Bengal, India –RS data usage in user orientation. Jour. River Research Inst. River Behaviour & Control. Silver Jubilee Vol(25). pp 19-28.
(1998) :Rs and GIS : Spatial format for sustainable resource development. MGMI Trans. Vol.97. No. 1&2. pp 29-37.
1999) : Land evaluation – Geo-information : Pragmatic input for landuse planning. Int. Confer. Vol. 'Geo-informatics beyond 2000'. IIRS, Deheradun. pp. 187-196.

3. Chakrabarti, P. & Nag, S. (1998) : Geo-informatics : Spatio-thematic information for Natural hazard/disaster mitigation. IAPRS

& SIS, Vol. 34 part 7. 'Resources & Environmental Monitoring', Hyderbad, India pp 1198-1201.

(1998) : Geo-informatics in environmental impact assessment – a paramtric approach. Indian Jour. Earth Science. Presidency College, Calcutta. Vol.- 25. No. 1-4 pp 108-114.

4. Chakrabarti, P, et. Al. (1995) : IMSD (spl) Project Reports on Chhatna Block. Bankura dist. And Baghmundi Block, Puruliya dist. West Bengal (Unpublished). State Remote Sensing Centre, DST & NES, Govt. of West Bengal.

   (1995) : IMSD Phase-II Project report on Dwarkeswar watershed, Puruliya dist. West Bengal. (Unpublished). State Remone Sensing Centre, DST & NES, Govt. of West Bengal.

   (1998) : Unpublished Report on 'Spatial planning and mangement of land & water resources, Kunur Basin, Barddhaman district, West Bengal, India, 'Remote Sensing Cell, DST & NES, Govt. of West Bengal.

5. Fabbri, A.G; Patrono, A. (1995) : The use of environmental indiacators in the geosciences ITC Jour. 1995-4 pp 358-366.

6. Meijrink, A.M.J. (1988) : Data acquisition and data capture through terrain mapping units. ITC Jour. 1988-1 pp 23-44.

7. Skidmore, A.K.et. al. (1995) : Use of Remote Sensing and GIS for sustainable land management. ITC Jour. 1997-3/4 pp 302-315.

8. Tri, L.Q. (1994) : Present landuse as a basis for land evaluation in the Mekong delta. ITC Jour. 1993-94 pp 377-385.

Transgenic Plants in Mercury Phytoremediation: A New Approach to Protect The Environment from Contaminating, Toxic, Heavy Metals

Saikat Kumar Basu

Abstract

Phytoremediation is rapidly gaining esteem as an innovative method to clean up heavy metal pollution. As conventional methods for mercury detoxification are prohibitively expensive, less costly strategies, such as phytoremediation are being examined as effective alternatives. Plants do not naturally possess the ability to detoxify mercury in soils at efficient rates, however, some bacteria do. Bacterial genes for reducing mercury have been characterized and introduced into several plant species. The resulting transgenic plants are able to proliferate on high levels of mercury and may be beneficial for use in phytoremediation. Though these preliminary results look promising, further insights into understanding the mechanisms behind mercury phytoremediation are required before it will be used commercially. The technology discussed in this paper

can be used in bioremediation of various other toxic heavy metals too.

Introduction

Phytoremediation is a rapidly evolving technology that uses plants to clean-up contamination from the air, soil and water. Since the Industrial Revolution environmental pollution has increased substantially and, unfortunately, has not been decontaminated at the same rate (Stokstad, 2004). This disequilibrium has resulted in high concentrations of toxic chemicals, detrimentally affecting various integral ecosystems across the globe. Unlike organic pollutants, which may be degraded by natural means, heavy metal pollutants are highly stable resulting in accumulation of these highly toxic compounds (Bennicelli *et al.,* 2004).

Traditional remediation methods for heavy metals, which include excavation and removal of contaminated soils, are considerably costly and highly disruptive to ecosystems (Glick, 2003). Alternatively, phytoremediation has several advantages that may allow its use in conjunction with, or in replace of,

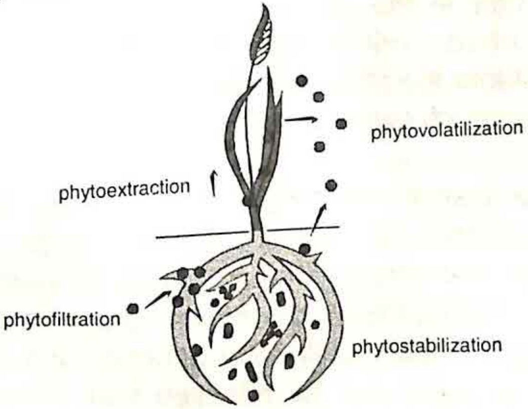

Figure 1 - Phytoremediation strategies for heavy metals
● (adapted from Pilon – Smits and Pilon 2000.)

standard remediation techniques (Henry, 2000). These advantages include: 1) requisite energy comes from sunlight, thereby reducing costs substantially; 2) it is non-intrusive, consequently preserving natural ecosystems and; 3) it remediates compounds in situ, thus reducing labor expenses.

Heavy metals can be remediated by plants in several ways as shown in Figure 1:

- Phytostabilization limits the dispersion of heavy metals or reduces their bioavailability in the soil (Vangronsveld *et al.,* 1995). Roots create an extensive network in the soil that can limit water movement that would normally leach contaminants. Also roots can reduce some heavy metals into less bioavailable forms.

- Phytoextraction removes heavy metals in the soil by hyperaccumulating them in the above-ground tissues of plants (Kumar *et al.*, 1995). Plants mobilize metals that are bound to soil particles by: secreting chelators or reductases, lowering the soil pH, or through the aid of rhizospheric organisms (Raskin *et al.,* 1997). Mobilized metals are then absorbed into the roots and transported into shoots or leaves, which can subsequently be harvested.

- Phytovolatilization detoxifies soils by converting heavy metals into volatile forms, which then evaporate and diffuse away in the air (Burken and Schnoor, 1999). Plants accumulate the toxic metal and convert it to a volatile form within tissues. Thus, the volatile metal can be released from either the roots or the shoots depending on the vascular transport mechanisms for the specific metal (Raskin *et al.,* 1997).

- Phytofiltration (also known as rhizofiltration) removes heavy metals from water, which has significantly lower pollutant concentrations than soil, by accumulating them in roots by precipitating and concentrating them (Dushenkov *et al.*, 1995). The biological mechanisms of phytofiltration vary greatly for different heavy metals but often involve intracellular uptake and compartmentalization (Raskin *et al.*, 1997).

Some limitations to phytoremediation are: 1) the level of tolerance to heavy metals, as plant growth is often partially or fully inhibited in the presence of heavy metals; 2) the penetration of the roots and, thus, the depth of soil that can be remediated and; 3) the length of time for the plants to grow (Cunningham *et al.*, 1995). Each of these restrictions may be lessened by an increased understanding of the underlying phytoremediation processes. It is critical to identify or create plants that are capable of high levels of phytoremediation in order for this process to become commercially employed. Of particular interest is the creation of transgenic plants that accumulate significant quantities of heavy metals (Black, 1995). Recently, the effects of mercury toxicity have been infiltrating mass media and a significant amount of research energy is being conducted for the development of effective methods for cleaning up mercury contaminated sites (Stokstad, 2004). Progress is being made in understanding the molecular mechanisms behind natural mercury hyperaccumulators and in using these mechanisms to engineer transgenic plants capable of mercury detoxification.

Mercury toxicity

Mercury is commonly released into the environment in its ionic form, Hg^{2+}, from industrial practices, medical waste, and gold mining. Once released into the environment the Hg^{2+} ion may be subsequently methylated by anaerobic bacteria, present in aquatic sediments, resulting in the formation of methylmercury (Meagher, 2000). Methylmercury is up to 200 times more toxic than Hg^{2+} and biomagnifies in the food chain becoming increasingly prejudicial to humans (Ruiz *et al.,* 2003).

Due to it high toxicity at exceptionally low doses, Hg is regarded as one of the most hazardous heavy metals (Castoldi *et al.*, 2001). Methylmercury is particularly toxic due to its hydrophobicity, allowing it to diffuse into cells and inactivate critical enzymes (Bizily *et al.*, 1999). Once inside cells, methylmercury binds to thiol groups found on cysteine residues of proteins, which severely disrupts protein function (Bizily *et al.*, 1999). Even in low doses, such as those consumed from eating fish, methylmercury adversely affects the neurological development of fetuses and children (Castoldi *et al.*, 2001). Methylmercury is harmful not only to mammals, but it also negatively affects plants that may be used for phytoremediation.

During the requisite uptake of essential metals from the soil, heavy metals may enter plant tissues through nutrient transport systems, where they may negatively impact cell growth (Meagher, 2000). Additionally, Hg causes significant damage within the thylakoid membranes and interferes with the photosynthetic proteins (Ruiz *et al.,* 2003). Hg may also replace Mg in chlorophyll molecules, reducing overall chlorophyll content in cells and further decreasing photosynthetic capacity (Ruiz *et al.,* 2003).

Most native flora cannot grow in areas that are highly contaminated with any heavy metals, and those that do are shrubby, tolerant species that hyperaccumulate heavy metals (Rugh *et al.*, 1996). *Azolla caroliana* is the solo species that has the innate ability to naturally hyperaccumulate Hg (Bennicelli et al., 2004). Conversely, many bacteria can resist the harmful effects of methylmercury and are ubiquitous to mercury contaminated sites. Their remarkable resistance to Hg is due to a group of genes located within the mer operon (Wang *et al.*, 1987). The major genes have been identified and characterized: merR (regulation), merT and merP (transport), merA (mercuric reductase) and merB (organomercurial lyase) (Huang *et al.*, 1999). MerB catalyzes the protonolysis of methylmercury (or other organomercurials) into Hg^{2+} and methane as shown in Reaction 1. Hg^{2+} is then reduced by MerA to the volatile, elemental Hg^0 that can be easily eliminated from the cell as shown in Reaction 2. MerA is an NADPH-dependent, oxidoreductase belonging to a family of proteins that reduces many organic compounds such as Au3+, Ag^+, Cu^{2+} and Cd^{2+} (Rugh *et al.*, 1996).

Reaction 1 (MerB)	$CH_3Hg^+ + H^+ \rightarrow CH_4 + Hg^{2+}$
Reaction 2 (MerA)	$Hg^{2+} + NADPH + OH^- \rightarrow Hg^o + NADP^+ + H_20$

Despite the promise of this bacterial system as a remediation tool, the rate of bacterial Hg^0 volatilization is too slow to be practical (Rugh *et al.,* 1996). Plants, on the other hand, have a larger biomass and therefore, a greater remediation potential than bacteria; however, plants do not naturally evolve Hg^0 at reasonable levels. Engineering plants with the bacterial mer genes may circumvent this problem by creating plants that can hyperaccumulate Hg and successfully remediate polluted sites (Bennicelli *et al.*, 2004).

Transgenic plants

The wild type, bacterial merA gene is not suitable for expression in plants due to the presence of a large number of CpG motifs (sites for methylation and silencing), bacterial codons that are not highly expressed in plants, and many GC–rich regions (Rugh *et al.,* 1998). Therefore, merA needs to be modified in order to be compatible in the plant genome (Rugh *et al.,* 1996). A highly modified *merA9* gene under the control of a 35S promoter was constructed for use in transgenic studies (Rugh *et al.,* 1996). *merA9* has a 9% block of the coding sequence and altered noncoding flanking regions and confers a high level of expression when introduced into plants.

Several plant species have been engineered containing the *merA* construct: transgenic *Arabidopsis thaliana* plants were created through *Agrobacterium tumefaciens*-mediated transformation of embryos (Rugh *et al.,* 1996); transgenic yellow poplar proembryonic masses were transformed (Rugh *et al.,* 1998) and; *Nicotiana tabacum* leaf disks were transformed by *Agrobacterium tumefaciens*-mediated transformation are three such examples (He *et al.,* 2001). In all cases, the transgenic seedlings or plantlets were resistant to toxic levels of Hg^{2+} and grew equivalently to wild-type controls on media lacking mercury; in addition, transgenic plants evolved much more Hg^0 than control plants (Rugh *et al.,* 1996; Rugh *et al.,* 1998; He *et al.,* 2001). Interestingly, transformed plants were less hardy than control plants grown on media that did not contain mercury (Rugh *et al.,* 1996). This differential growth may be due to the capacity of MerA to reduce a wide range of ions, some of which may be essential for the plants. This result may be beneficial in containing transgenic species to areas with mercury pollution (Rugh *et al.,* 1996). The rate of mercury volatilization was also examined in distinct regions of the tobacco plants and it was shown that the roots evolved up to five times more Hg^0 than the shoots or leaves (He *et al.*, 2001).

A *merB* gene was constructed and used to transform *Arabidopsis thaliana* in a similar manner as described above (Bizily *et al.,* 1999). The transgenic plants grew well on concentrations of methylmercury that were lethal to control plants (Bizily *et al.,* 1999). Since organic mercury is more hydrophobic and can accumulate to higher concentrations inside cells than Hg^{2+}, plants possessing the ability to convert methlymercury to Hg^{2+} may accumulate high enough levels of Hg^{2+} to pose a serious threat to cellular functioning. Because these transgenic plants were still viable, they must have been able to tolerate high levels of Hg^{2+}. It is postulated that cytoplasmic chelators bind to Hg^{2+} and sequester it, thus offering some protection for the cell (Bizily *et al.,* 1999).

Arabidopsis thaliana plants transformed with both *merA* and *merB* genes have the ability to directly convert methylmercury into volatile Hg^0 (Bizily *et al.*, 2000). These double expression, transgenic plants were able to grow on media containing extremely high concentrations of methylmercury compared to wild-type plants, and grew on a 10-fold higher concentration relative to *Arabidopsis* transgenic for the *merB* gene alone (Bizily *et al.*, 2000). Via experiments performed with these double expressors, it was shown that both *mer* genes are necessary for plants to have the ability to remediate methylmercury into elemental mercury (Bizily *et al.,* 2000).

The diffusion rate of methylmercury to the cytoplasmically expressed MerB protein is the limiting factor in the reaction rate for mercury volatilization (Bizily *et al.*, 2000). Thus, a *merB* gene construct was created that targets MerB to the cell wall to circumvent the problem of slow diffusion of hydrophobic methylmercury in the cytoplasm (Bizily *et al.,* 2003). Plants containing this construct along with the *merA* gene had 10-70 times higher Hg^0 volatilization than plants with the cytoplasmically distributed MerB (Bizily *et al.*, 2003).

More experiments have been conducted to target MerB to specific locations in the cell in order to improve the efficiency of mercury volatilization (Ruiz *et al.*, 2003). It is hypothesized that Hg primarily affects the thylakoid membranes in plants and, therefore, this is an ideal target for MerB proteins. The aforementioned studies created transgenic plants using the nuclear genome; whereas, a novel experiment integrated both the *merA* and *merB* genes into the chloroplast genome of *Nicotiana tabacum* (Ruiz *et al.*, 2003). The advantages of this approach over nuclear transgenic methods are several: 1) higher levels of transgene expression; 2) maternal inheritance (decreasing transgene contamination of native species); 3) decreased gene silencing, and; 4) bacterial gene expression without the need to optimize codons (Ruiz *et al.*, 2003). Transgenic tobacco plants were resistant to toxic levels of organomercurial compounds and had more chlorophyll per unit of dry leaf weight (Ruiz *et al.*, 2003).

While *Arabidopsis thaliana* and *Nicotiana tabacum* are good genetic model systems, in order to efficiently remediate polluted wetlands, species that naturally inhabit those environments must be used in transgenic studies. The first transgenic wetland plant for remediation of mercury was developed by the introduction of *merA* into rice (*Oryza sativa L.*) by particle bombardment (Heaton *et al.*, 2003). Another wetland species, the Eastern cottonwood (*Populus deltoides*) was transformed with a modified *merA* gene construct (Che *et al.*, 2003). Both transgenic species were able to proliferate on media containing enough Hg^{2+} to completely inhibit control plants, and they also volatized a significant amount of Hg^0 compared to their wild-type counterparts (Heaton *et al.*, 2003;

Che *et al.*, 2003). These results look promising for using these wetland species for phytoremediation of mercury polluted waters and soils. Future studies should look into increasing the efficiency of Hg^{2+} extraction in wetland plants as well as introducing *merB* to volatize methylmercury directly.

Future

Further understand is needed with respect to the limiting factors in phytoremediation for further adaptation of plant species as bioremediators. Creating plants that can tolerate stressful environments by regulating the synthesis of stress hormones may be beneficial to obtaining high biomass plants on mercury contaminated sites. It has been previously reported that rhizospheric bacteria facilitate the uptake of mercury by wetland plant species (de Souza *et al.*, 1999) and the symbiotic interaction of plants and rhizospheric organisms needs greater attention. In order for phytoremediation to be feasible, it may be necessary to cultivate transgenic plants with bacteria and fungi that promote plant proliferation.

Additionally, research is needed to identify or create novel proteins that may be used to detoxify methlymercury. Screening expression libraries from diverse species may isolate specific peptides that bind mercury. It may also be possible to add mercury binding domains to synthetic genes and incorporate these construct into plants to increase their ability to hyperaccumulate mercury.

Finally, more transgenic aquatic plants, such as cottonwoods and willows, should be developed and studied. Wetland ecosystems are easily disturbed and wetland plants are not generally hyperaccumulators of heavy metals (Weis and Weis, 2004). Also these trees have a long lifespan and very extensive root systems thereby making them excellent candidates for long-term phytoremediation strategies.

Extensive research is currently being conducted to develop phytoremediation as a viable strategy to clean up environmental pollution. While many findings look promising, much more information needs to be gained in order to create an efficient phytoremediation technology for the clean up of mercury. Hopefully with advancements in this field, phytoremediation will be used commercially in the near future.

References

1.Bennicelli R., Stępniewska Z., Banach A., Szajnocha K., Ostrowski J. (2004). The ability of *Azolla carolinia* to remove heavy metals (Hg(II), Cr(III), Cr(VI)) from municipal waste water. Chemosphere, 55: 141-146.

2.Bizily S.P., Rugh C.L., Summers A.O., Meagher R.B. (1999). Phytoremediation of methylmercury pollution: *merB* expression in *Arabidopsis thaliana* confers resistance to organomercurials. PNAS, 96: 9808-6813.

3.Bizily S.P., Rugh C.L., Meagher R.B. (2000). Phytodetoxification of hazardous organomercurials by genetically engineered plants. Nature Biotechnology, 18: 213-217.

4.Bizily S.P., Kim T., Kandasamy M.K., Meagher R.B. (2003). Subcellular targeting of methylmercury lyase enhances its specific activity for organic mercury detoxification in plants. Plant Physiology, 131: 463-471.

5.Black H. (1995). Absorbing possibilities: phytoremediation. Environmental Health Perspectives, 103: 1106-1108.

6.Burken J.G. and Schnoor J.L. (1999). Distribution and volatilisation of organic compounds following uptake by hybrid poplar trees. International Journal of Phytoremediation, 1: 139-151.

7.Castoldi A.F., Coccini T., Ceccatelli S., Manzo L. (2001). Neurotoxicity and molecular effects of methylmercury. Brain Research Bulletin, 55: 197-203.

8.Che D., Meagher R.B., Heaton A.C.P., Lima A., Rugh C.L., Merkle S.A. (2003). Expression of mercuric ion reductase in Eastern cottonwood (*Populus deltoides)* confers mercury ion reduction and resistance. Plant Biotechnology Journal, 1: 311-319.

9.Cunningham S.D., Berti W.R., Huang J.W. (1995). Agronomic Remediation of contaminated soils. Trends in Biological Sciences, 13:393-397.

10.de Souza M.P., Huang C.P.A., Chee N., Terry N. (1999). Rhizosphere bacteria enhance the accumulation of selenium and mercury in wetland plants. Planta, 209: 259-263.

11.Dushenkov V., Kumar P., Motto H., Raskin I. (1995). Rhizofiltration: the use of plants to remove heavy metals from aqueous streams. Environmental Science & Technology, 29: 1239-1245.

12.Glick B.R. (2003). Phytoremediation: synergistic use of plants and bacteria to clean up the environment. Biotechnology Advances, 21: 383-393.

13.He Y.K., Sun J.G., Feng X.Z., Czako M., Marton L. (2001). Differential mercury volatilization by tobacco organs expressing a modified bacterial *merA* gene. Cell Research, 11: 231-236.

14.Heaton A.C., Rugh C.L., Kim T., Wang N.J., Meagher R.B. (2003). Toward detoxifying mercury-polluted aquatic sediments with rice genetically engineered for mercury resistance. Environmental Toxicology Chemistry, 12: 2940-2947.

15.Henry J.R. (2000). An overview of the phytoremediation of lead and mercury. NNEMS, 1-51.

16.Huang C.P.A.., Narita M., Yamagata T., Endo G. (1999). Identification of three *merB* genes and characterization of a broad-spectrum mercury resistance module encoded by a class II transposon of *Bacillus megaterium* strain MB1. Gene, 239: 361-366.

17.Kumar P., Dushenkov V., Motto H., Rasakin I. (1995). Phytoextraction: the use of plants to remove heavy metals from soils. Environmental Science & Technology, 1995:1232-1238.

18.Meagher R.B. (2000). Phytoremediation of toxic elemental and organic pollutants. Current Opinions in Plant Biology, 3: 153-162.

19.Pilon-Smits E. and Pilon M. (2000). Breeding mercury-breathing plants for environmental cleanup. Trends in Plant Science, 5: 235-236.

20.Raskin I., Smith R.D., Salt D.E. (1997). Phytoremediation of metals: using

21.plants to remove pollutants from the environment. Current Opinion in Biotechnology, 8: 221-226.

22.Rugh C.L., Wilde H.D., Stack N.M., Thompson D.M., Summers A.O., Meagher R.B. (1996). Mercuric ion reduction and resistance in transgenic *Arabidopsis thaliana* plants expressing a modified bacterial merA gene. PNAS, 93: 3182-3187.

23.Rugh C.L., Senecoff J.F., Meagher R.B., Merkle S.A. (1998). Development of transgenic yellow poplar for mercury phytoremediation. Nature Biotechnology, 16: 925-928.

24.Ruiz O.N., Hussein H.S., Terry N., Daniell H. (2003). Phytoremediation of organomercurial compounds via chloroplast genetic engineering. Plant Physiology, 132: 1-9.

25.Vangronsveld J., van Assche F., Clijsters H. (1995). Reclamation of a bare industrial area contaminated by non-ferrous metals: in situ metal immobilization and revegetation. Environmental Pollution, 87: 51-59.

26.Wang Y., Mahler I., Levinson H.S., Halvorson H.O. (1987). Cloning and expression in Escherichia coli of chromosomal mercury resistance genes from Bacillus sp. Journal of Bacteriology, 169: 4848-4851.

27.Weis J.S. and Weis P. (2004). Metal uptake, transport and release by wetland plants: implications for phytoremediation and restoration. Environment International, in press.

Environmental Information System in India : Fundamentals and Perspectives

Subarna Kumar Das

Introduction

Environment is the source of life on earth and it not only directs but also determines the existence, Growth and development of mankind and all its activities. Primitive man ate wild fruits- hunted and fished- and relied heavily on nature for his very existence. Even these basic actiuvities damaged nature to some extent. At that time, man did not concern himself with conservation methods. As society developed, man's impact on environment grew in scope and strength. Mankind has long trusted in nature's potential and restorative powers inexhaustible only recently man has come to realise the necessity for conservation. This is the result of revolution in science and Technology which has dramatically increased man's ability to use natural environment and its resources. Nature has been increasingly damaged restorative capabilities have progressively weakened and human environment is deteriorating day by day to the point of affecting not only the Quality of life but even the very existence of life. AT this point, man realised the need to preserve and improve his environment. The human environment is the earth we live on. It includes all physical parts of the earth, such as air, soil, minerals, rocks and water, and all its living organisms such as animal and plants. It is also a search for solutions to the environmental problems that confront us. In fact, environmental science is a vast subject, including all those branches of knowledge which deal with ecology as an interdisciplinary science drawing upon subjects like Zoology, Botany, Geography as well as social, natural and management sciences (1) . On the basis of above thinking environmental Information System have been developed.

Environment

The Term 'environment' eytomologically means surroundings. Literally, it is an english word formed by two words, i.e., 'environ' and 'ment' which means 'encircle' or 'all round'. Thus, environment is a complex of many variables which surrounds man as well as all living organism. Any external force, substance or condition, which surrounds and affects the life of the organism in any way becomes a factor of its environment. These factors have been variously called as environmental factors, ecological factors or simply, factors and may be living, biotic, as well as non- living, abiotic. The sum of these living and non- living factors makes the environment of an organism. The place where an organism lives is called 'habitat'. It is also known as 'milieu' which means " total set of surroundings". In fact, habitat is a part of the earth's surface where life originates and develops according to the geographical conditions. Moore (1967) in his book A Dictionary of Geography, has defined as "the natural environment of plant or animal. It is often expressed as one of the main natural regions or one of their sub-divisions. The encycopaedic definition of environment is as under:

The entire range of external influences on an organism both the physical and biological (in other organism) forces of nature surrounding an individual" (Encyclopaedia Britannica)

Environmental Information System (ENVIS) in India

The Government of India set up the National Committee on Environmental Planning (NCEP) in 1972. This was the first comprehensive effort at environmental planning and protection on the part of the national government. A survey carried out by the National Environmental Engineering Research Institute (NEERI) in 1976 revealed that there were than 220 organization in India, which were carrying R & D work in one or the other aspect of the environment. The Government of India realized that the environmental protection should constitute an integral part of the planning process in order to achieve the sustainable development. The sustainable development has been defined as a pattern of social and structured economic transformations (i.e. development), which optimizesthe economic and societal benefits available in the present, without jeopardizing the likely potential for similar benefits in future. It is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The Government of India put emphasis on environmental aspects in all the activities associated with national development plan and programmes. This was evident from the creation of an independent Department of Environment in November 1980 by the Government of India. Realizing the importance of environmental information, the Government of India, in December 1982, established an Environmental Information System (ENVIS) under the Ministry of Environment and Forests. The focus of ENVIS has been on providing environmental information to decision makers, policy planners, scientists and engineers, research workers, etc all over the country (2).

The ENVIS has started implementing the World Bank assisted Environment Management Capacity Building Technical Assistance Project (ENMCBTAP) since January, 2002 which aims at structuring the ENVIS scheme by extending its reach through involvement of institutions / organizations in State Governments, academia sector, corporate sector, NGO sector, etc. The project also aims at broadening the ambit of ENVIS to include varying subject areas, themes, local conditions, issues, information/data needs of the country pertaining to environment and planned to be achieved through enlargement of participatory organizations/institutions, called EMCB-Nodes in various sectors and through introduction of modern means of Information and Communication Technologies (ICTs). This programme is a continuation of the Sustainable Development Networking Programme : India (SDNP-Inida), funded jointly by the UNDP and IDRC, Canada and operational in more than 80 countries. SEINet (SAARC Environment Information Network) has been established to assist SAARC member countries for protection and preservation of the environment. SEINet would be developing the database on various local and global environmental issue and would disseminate the information using the latest IT and by development a website (3).

Objectives of ENVIS

The objectives of ENVIS as envisaged are :

(i) Allocation of responsibilities to different institutes and organizations for building up strong collection of special subject fields related to environment.

(ii) Development of facilities for providing national environmental information service relevant to the future needs and capable of development to meet the future needs of the nation.

(iii) Establishment of a repository and dissemination centre in Environmental Science and Engineering.

(iv) Establishment of a databank for scientific and techno-economic information related to environment.

(v) Establishment of a national referral centre to direct the users to the existing environmental information sources.

(vi) Collaboration with national and international organizations engaged in environmental information services.

(vii) Promotion of national and international cooperation and liaison for exchange of environmental related information.

(viii) Development of information handling capabilities with the aid of modern technologies in the areas of acquisition, processing, storage, retrieval and disseminationof environmental information. (4)

Structure of ENVIS Network

Since Environment as a subject is multidisciplinary in nature, a comprehensive information system on environment calls for the effective participation of concerned institutions and organizations in the country that are actively engaged in the study and research of different subject areas of environment. Various government departments, research institutions, societies, associations and universities are engaged in R & D activities in the different areas of environmental problems and the libraries and information centres attached to them provide information supporting to their activities. ENVIS has, therefore, developed itself with a network of such participating institutions and organizations. The ENVIS Network at present consists of 25 subject specific nodes, known as ENVIS centre, located in various institutions throughout the country. The National Focal Point (NFP) of ENVIS is located in the Ministry of Environment and Forests of the Government of India. (5)

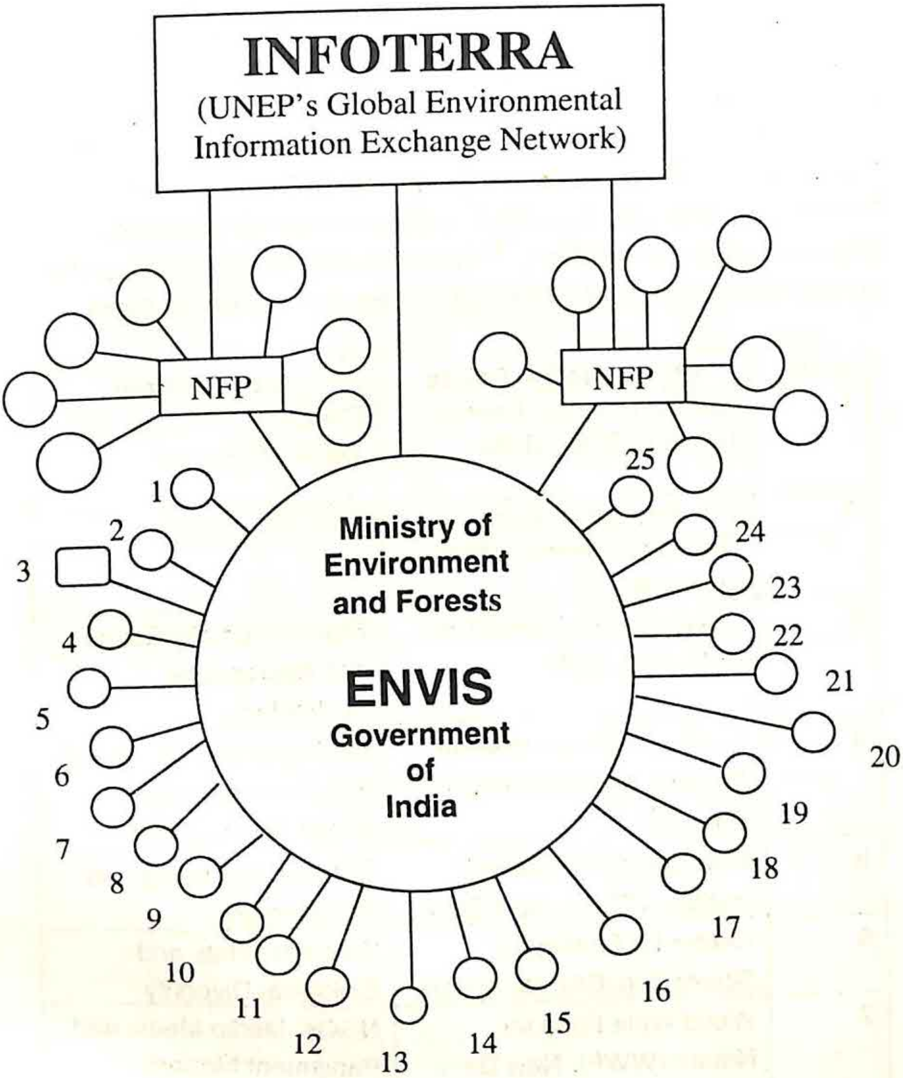
INFOTERRA
(UNEP's Global Environmental Information Exchange Network)
NFP
NFP
Ministry of Environment and Forests
ENVIS
Government of India
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Figure 2 : Structure of ENVIS

National Focal Point of ENVIS

Information base of the ENVIS Focal Point in the Ministry is being continuously strengthened through the acquisition of relevant publications, scientific and technical reports, bibliographies, journals, monographs, directories, state-of-the-art reports, databases, etc. on several aspects of environment. The information base is also eniched by the documentation support provided by the network partners, i.e. ENVIS centres. The library in the Ministry forms an integral component of the ENVIS and acts as document repository for dissemination of environmental information. (6) The following table furnishes the ENVIS nodal points and the subject areas covered by them :

Sl.No.	ENVIS Nodal Points	Area Covered
1	Central Pollution Control Board (CPCB), Delhi	Control of Pollution (Air, Water and Noise)
2	Industrial Toxicology Research Centre (ITRC), Lucknow	Toxic Chemicals
3	Development Alternatives (DA), New Delhi	Environmentally Sound and Appropriate Technology
4	Centre for Environmental Studies, Anna University, Chennai	Biodegradationof Wastes and Environmental Impact Assessment
5	Tata Energy Reasearch Institute (TERI), New Delhi	Renewable Energy and Environment
6	Centre for Ecological Sciences (CES), Bengalore	Western Ghats and Biological Diversity
7	World Wide Fund for Nature (WWF), New Delhi	NGOs, Media Media and Parliament Matters related to Environment

8	Indian Environmental Society, Delhi	Panchayati Raj and Environment
9	National Institute of Occupational Health (NIOH), Ahmedabad	Occupational Health
10	Central Arid Zone Research Inswtitute (CAZRI), Jodhpur	Desertification
11	Centre for Advanced Studies in Marine Biology (CASMB), Annamalai University, Tamilmadu	Marine Biology - Estuaries - Mangroves - Lagoons - Coral reefs
12	Centre for Environment Education (CEE), Ahmedabad	Environment Education
13	Zoological Survey of India (ZSI), Kolkata	Faunal Biodiversity
14	Indian School of Mines (ISM), Dhanbad	Environmental Problems of Mining
15	National Environment Engineering Research Institute (NEERI), Nagpur	Environment Engineering - Solid Wastes including Hazardous Wastes
16	G B Pant Institute of Himalayan Environment and Development (GBPIHED), Kosi-Katarmal (U.P.)	Himalayan Ecology
17	School of Planning and Architecture (SPA), New Delhi	Human Settlement

18	School of Environment Sciences (SES), Jawharlal Nehru University, New Delhi	Bio-Geochemistry and Environmental Law
19	Botanical Survey of India (BSI), Kolkata	Floral Biodiversity
20	Environment Protection Training and Research Institute (EPTRI), Hyderabad	Eastern Ghats Ecology
21	Bombay Natural History Sociery (BNHS), Mumbai	Aviation Ecology and Inland Wetlands
22	Forest Research Institute (FRI), Dehradun	Forestry
23	Wildlife Institute of India (WII), Dehradun	Wildlife and Protected Areas
24	Centre for Media Studies, New Delhi	Media related to Environment
25	State Council of Science and Technology for Sikim, Gangtok	Ecotourism

(7)

Conclusions

Information on different aspects of environment is expanding rapidly. The advent of Internet has brought this information directly in the hands of the researchers. In spite of the establishment of ENVIS under the Ministry of Environment and Forests of the Government of India for the purpose of interconnecting various independent information centres through networking, it is generally found that most of these information centres work in isolation and there is a lack of co-ordination in their activities. Many a times they are not aware of what others are doing and what has already been done by others.

7. References

1. Saxena (H.M.) : Environmental Management, Jaipur : Rawat Publications, 2000, Pg – 11
2. Prasad (RC) and others : Environmental Information System Network in India : An Overview, ILA Bulletin, 33,1-2; 1997, P.5-10.
3. Ibid.
4. Singh (Harjit) : Environmental Information System in India. DESIDGC Bulletin, 19, 2; 1999.P.5-12.
5. Envis (http:// www. envfor. nic.in/envis/fpsrv.html. (visited on 7.12.2004)
6. Ibid.
7. Prasad (RC) and others . Ibid.

Climate Change and Our Country – An Apology For A Debate

Subhasis Mukhopadhyay

Prelude

Climate, weather, environment, technology and a whole host of words have become buzz-words now-a-days. From an ordinary individual to research scientists of an established R & D laboratory, political leaders of various hues, even the Hon'able Justice of the Supreme Court of our country seem to have a consensus about the meaning of these terms. In the international arena, two successive twice elected Presidents of the almighty United States of America, Mr. Bill Clinton to "baby" George Bush would also prefer to use these terms in one go! Looks like it that is a consensus operating at all levels? Or, is there any really?

No sane person can ever doubt that every country under the Sun will have their solemn rights to choose and to pursue a course of development, to chart a growth path with a suitable choice of technology and be happy with it. Up to this proposition, there cannot be and there possibly isn't any debate. But one cannot help but to engage oneself into a serious debate, when it turns out that the "development path" chosen by one, can irreversibly be detrimental to many others. The debate continues on and on, a game of blame ensues, and in most of the cases, as it happened in the past, one arrives at a "solution" by application of force. Climate change is one such area where hot debates are going on which has already crossed the arena of "pursuit of pure knowledge", as, we will show in the article, it affects nearly all of us.

Climate Change – Rival Views

Before we begin, we would like to summarise the debate centred around the moot points. The methodology that we would like to adopt is to mention only the strongest and the most prevalent view held by the proponents and the opponents and would try to take a balanced position as suggested by the arguments.

There is always a misunderstanding about the word change. At the very outset, we would like to strongly assert that all the spheres (I.e., biosphere, hydrosphere, lithosphere etc.) in our earth have undergone and are undergoing continuous change, even if we ignorant about it. All of them evolved in the past and are still evolving; they are at various phases of evolution and we usually have a glimpse, a snap-shot of them in their respective path of evolution. These changes are entirely governed by the laws of nature, no matter whether we understand them fully or not. Also, contrary to the prevalent popular belief, they are not evolving according to a "cosmic blue print". To push the frontier of knowledge, humankind started enriching the general pool of wisdom, and this quest marks a cardinal step in the history of epistemology. Thus changes in things are the rule, rather than an exception.

This changes take place in a space and time frame. According to the current paradigm, the climate changes along with the changes that we observe in our mother Earth, we can associate two different time scales pertaining to the changes that invariably take place around us. One of the time scale may be defined to the shorter time scale, spanning perhaps 90 years or so (a time-frame in which three human generations are expected), and the other one to be the longer time scale, spanning perhaps the duration in which a few species in the earth would go extinct. The shorter time scale is measured in terms of a few years, while the longer one would be measured in terms of a few thousand years.

In this article, we would like to limit ourselves in elaborating the effects of climate change that would affect our country, or for that matter the entire world. Before we begin, let us first define the terms climate and weather, because in this debate, a group often confuses the meaning of these two concepts and engage themselves into futile debates.

By weather we mean a particular state of our atmosphere at a given instant; the state is characterized by and to a great extent, governed by the then value of temperature, amount of water vapour present, wind speed, barometric pressure etc., of the atmosphere. All these are measurable parameters, and the combinations of the values of these parameters determines to a great extent the weather at that instant. The earth's rotation about its own axis as well as its diurnal make the weather of our earth a tremendously variable phenomena whose complete unfolding is not yet known to us as of today. But that does not in any way mean that we cannot predict anything about the weather. We can certainly predict major changes and the likely direction(s) along which the changes may take place. We now have exclusive weather satellites, which gather data about the major parameters which may affect and accentuate the observed weather changes; we have now credible mathematical models and high speed digital computers to predict possible changes. The results of all these translate into the fact that we know the rough periodicity of certain recurrent phenomena and some predicting power as regards broad and major happenings. On the contrary, by climate we mean the changes that take place over the longer time frame of the weather, the nature of these changes and the various trends that are likely to emerge over this longer time frame. These long term, unidirectional and mostly irreversible changes are characterized by the long term average of a set of more or less measurable parameters. Some of them are the mean temperature of the atmosphere, mean rate of evaporation etc. A combination of these mean values of some of these parameters are supposed to be the indicators of the climate change, that had taken place in the past and the changes that are going to take place in the future (near or far). No matter, whether these changes take place over the shorter time frame or longer time frame, that I the rule rather than an exception and there is no escape from these rules; we need to adjust ourselves and align our activities consistent with these rules. We must not forget that it is the climate change that is responsible for the history of living being in our earth, it is this climate change that wrote the history of humankind, responsible for the rise and fall of ancient civilizations that we know and are proud of. It is this climate change that is responsible for the major environmental calamities, epidemic and natural disaster. We cannot ignore the evidences of this climate changes engraved in the neutral chronicle of geology and archeology. Whether we like it or not, the effect of climate change affects our activities, shapes our economics; this in urn generates certain influences on the climate. This reciprocity relation is very important, the entire ramifications of which are very poorly understood; we are beginning to get a glimpse of what these relations could be.

Already the effects of climate changes are visible around us, and these changes have started affecting the biodiversity of this planet, affecting the economic activities, generating political and military tensions among nation-states. This is happening in our life time. Thus very many pertinent questions are now raised. The changes in the environment, which is natural and various species are trying to adopt themselves with these changes according to Darwinian principle, are the being affected due to anthropogenic activities? If so, to what extent? Has it reached that alarming proportion so as to threaten the very existence of life on earth in the long run? The debate regarding the climate change is centred around all these cardinal questions. We may cite one very well-known example to drive home the point that long term changes in the climate can indeed result in a dramatic changes in the environment of the earth. As and when the mean temperature of the earth remained fixed around a particular value for a long time and the level of carbon di-oxide in the atmosphere reached a particular value, the plant kingdom did not come into being. Once again, as long as the level of oxygen in the atmosphere reached a particular value due to photosynthesis activities of the plants – the aerobic life on earth was not possible. We all know roughly the time frame involved with these momentous events in the history of life on earth. The carbon and the oxygen cycle we are familiar with today have reached a kind of an equilibrium which makes it possible for the life on earth to thrive. These exchanges of carbon and oxygen makes us dependent on the plant kingdom and this symbiotic relation relies heavily for its survival on the very equilibrium that has been achieved over these longer time frame. Thus this equilibrium enables and the plants to engage in autonomous activities to a great extent, yet remain dependent on each other. If the human autonomous activities are such that it stretches this equilibrium too far, then possibly we are in for trouble. Let us say, some insane ruler of some powerful country, decided for himself that he is going to clear out all the forest, would destroy all of the plant life, and wanted to create recreational facilities for the world citizens on the space thus vacated. We can well imagine what is going to happen and one can simulate such a scenario with the help of a disaster movie perhaps! One thus would have to be very much cautious so that we may not commit a similar folly.

Climate Change and The Global Warming

The atmosphere of the earth is squarely responsible for the mean hotness of the earth. The incident rays from the sun towards the earth are absorbed by the gases present in the atmosphere at various degrees. Among various gases which absorbs heat from the sun, the major role in absorbing the heat is played by carbon di-oxide, nitrus oxide and water vapour. The gases provide a sort of a warm blanket to the earth; had this cover not been there, the average temperature of the earth would have been a good eighteen degrees below the freezing point! The comfortable temperature which provides the basis for life in the earth, we owe heavily to these gases. But at the same time, this blanket would have kept us warm forever by raising the temperature continuously, but there is another, opposite process running in the atmosphere, whose job is to lower the temperature. The net effect of those two opposite processes reaches an equilibrium and results in a temperature comfortable for the life on earth. The equilibrium of these two processes pays a cardinal role in sustaining the life on earth. The question, thus can be asked as follows: are we tampering with this equilibrium by our social and economic activities? It is quite possible if we gravitate one of the processes to proceed unilaterally, thus the system may go to a state far away from the equilibrium in a n irreversible manner. This may well happen if the amount of heat-absorbing gases in the atmosphere accumulated to such an extent that the opposite process will not be able to cool the atmosphere to the required level. The fossil fuels we burn (in the thermal power plants, our cars etc.) contribute towards these so-called gases (gases known to be responsible for trapping the heat from the sun rays) and may well off-set the equilibrium. There is a common consensus among the climatologists that this has started happening. The extra load of green house gases that are being emitted daily and gets accumulated in the atmosphere has surely started shifting the equilibrium towards the hotter side. Thus a debate is raised that whether we can compensate the damage that has already been done to the climate of the earth and whether we can restore or arrest the shift of this equilibrium. This, in a nut-shell, is the scientific basis and the perspective of the debate about global warming and the attendant climate change.

International Reactions

From 1980 onwards, it was becoming more and more clear that there would certainly be global warming due to anthropogenic activities. If the current trend of energy usage remains unaltered, then the expected changes would be detrimental to the life on earth. When scientists from various disciplines, along with the climatologists have come to a consensus, United Nations, in 1988 has taken an initiative to form the Intergovernmental Panel on Climate Change (IPCC). The various preliminary reports of this IPCC made it apparent that the ameliorative measures will have to be taken by all the nation-states as a whole. In 1992, the Earth Summit in Rio has unanimously accepted the statements made at the Conference on Environment and Development by the UN Framework Convention ob Climate Change. With this agreement, 188 countries of the world had agreed to reduce the emission of greenhouse gases in their respective countries. But this agreement did not have a locus standi to be implemented as a law or a treaty, thus most of the countries did not initiate any effective actions to implement it.

In 1997, in the city of Kyoto, Japan, a Protocol was agreed upon and the Protocol has been made to be obeyed mandatorily by the convention countries. This Protocol, among other things, specified as how much reduction in the emission of green-house gases is to be made by the convention countries and time frame of such a reduction. Despite efforts from the poorer countries, the imperialist countries of the world got huge concessions towards the reduction of emission of the green-house gases, and the burden has been transferred to the poorer nations of the world.

Those countries, who contribute 55% of all of the green-house gases, will have to abide by the protocol from the day of its effect. Even if these countries received a lot of undue concessions, yet they are not too eager to implement this Protocol in their respective countries. For such an immoral action, the leadership was obviously assumed by the self-appointed leader – the USA. Though they are a party to it from the day one, when the Protocol has assumed the status of an international law after ratification of the Russian Parliament, they walked out of the Protocol and continues to flout the norm respected by the entire world.

There is a strong school of thought, composed mostly of scientists and economists, who assertively maintain that there global warming and has no scientific basis and those who used to talk about this global warming are alarm-raisers and believers of catastrophe theory. One can very cogently summarise the arguments as follows:

Argument Number ONE

Even in this very year, we have experienced dire cold, the very next year is a hot one. Is there really any statistically significant correlation regarding temperature increase?

This can well happen as these two phenomena are pertaining to weather change while we are concerned about climate change. Even if the remains cold, still over the longer time frame, the mean temperature of the atmosphere of the globe may increase. Weather variations indeed lead to summer in one part of the globe, while simultaneously the other part of the globe may be reeling under a severe cold wave. This are short term phenomena, but the question we ask is what would happen over the longer time scale. In any particular year, thus the average temperature of the atmosphere can remain below the global average temperature, but that is just a fluctuation about the mean value!

From 1880 onwards, there are regular mechanisms of measuring the temperature of the atmosphere on a global scale, maintains the strict scientific methodology; we thus have quite a good database regarding the mean temperature around various parts of the globe. The amount of data that has been acquired over this 125 years or so, clearly indicate that the average night temperature is on the rise globally. The last ice age is known to have ended around 10000 to 13000 years before present, and from that point up o today, the average temperature of the earth has been increased between 5 to 9 degrees Fahrenheit. This averages to about one degree Fahrenheit per thousand years. But after the last ice age, the anthropogenic load of the green-house gases in the atmosphere was negligible. But today (actually for the last 500 years or so), the load of green-house gases in the atmosphere due to anthropogenic activities has assumed a significant proportion.

This has resulted in a much faster rate of rise of global temperature compared to the last 10000 years or so. If this rate of increase of global temperature remains unchecked, then it is expected that even in the short term time scale, we may witness a rise in global atmospheric temperature to the tune of 2 to 11 degrees Fahrenheit.

Argument Number TWO

Assuming that there is indeed a rise in temperature, but surely the rise is very small compared to the fluctuation of the average temperature between the day and the night. Is it really significant?

For weather fluctuations, this change is really insignificant, but from the global climatic point of view, this changes appear to be significant enough, we all know that a very small, indeed very small change (about a degree Fahrenheit over thousand years) finally led the earth from the ice age to its present phase, thus any further rise in temperature may play havoc.

Argument Number THREE

The total amount of green-house gases emitted from the natural sources that go into the atmosphere is several orders of magnitude higher than the amount of green-house gases being emitted due to anthropogenic cause. Thus anthropogenic cause has very little or no effect over the rise of temperature of the atmosphere.

There is no doubt that the total amount of green-house gases emitted from the plants, the earth, surface and the sea, to name a few sources, is certainly much higher than the amount being generated due to anthropogenic activities. But that does not mean that the absolute amount is indeed insignificant. For the last 0.42 million year before present up to the beginning of the so-called "Industrial Revolution" in Europe (around 1750 or so), the carbon exchange cycle was more or less in the equilibrium. Which simply means that the amount of carbon di-oxide being generated and the amount carbon di-oxide taken back did not result in a net increase in carbon di-oxide so as to cause am imbalance in the cycle. But since 1759 onwards, the human kind has embarked up on large scale activities leading to huge amount of fossil fuel burning, tree felling. Change in the landscape pattern etc. For these reasons alone, the green-house gas load to the atmosphere from the non-natural source has increased by 31%. This excess amount of is going to change the cycle to a great extend. Before the advent of the "industrial revolution" in Europe, the carbon exchange had a slow, regular but ever-changing rhythm; this anthropogenic load of the green-house gases has possibly made that rhythm an accelerated one and irregular as well, if not makes it an altogether chaotic one.

Argument Number FOUR

It may so happen that the changes in global temperature is due to the fluctuations solar rays and it known that solar activities do generate such fluctuations. Thus it has nothing to do with anthropogenic activities.

Fortunately today, we have very many atmospheric satellites and research platforms installed in the space specifically to conduct solar research. From the data generated by them, it is revealed that the solar ray fluctuations mainly occurs in two different time scales. One time scale involves about 10 years while the other involves about 100 years. Hence periodic effects may not have much impact on the life on earth (as weather change throughout the year does not make a species to go extinct though the changes are really drastic). One must not forget that the solar rays are just one among many factors responsible for the heat that the atmosphere receives. With due and careful measurements as well as from the theoretical calculations, solar and astrophysicists have shown that the fluctuations in the amount of solar rays due to solar activities contributes just about 8% of the contributions made by the anthropogenic green-house gases. Thus if one makes a comparison regarding the relative weightages of solar activities vis-à-vis anthropogenic activities, the latter must preponderate over the former.

It may not be out of place to mention that the climate is such a complex system that any predictions about its future invariably involves unknown factors and limits the predictive values to certain gross trends and parameters. It may also be mentioned that the gross trends and gross predictions made can be reasonably measured and a balanced statement can certainly be made. No doubt, there are ifs and buts as regards the feasibility of global warming; scientists have indeed come out with rival scenario, there are contrary indications and explanations. But on the main, the scientific opinion tends to favour the global warming scenario.

Are Our Measurements About Global Warming Accurate Enough?

The measurements are routinely done for the last one century or so and the trend that one can isolate clearly show that it is quite possible that the global temperature would rise by 0.3 to 0.6 degree Celsius per century. These measurements are performed near the surface of the earth, by measuring the temperature of the atmosphere with balloon and extra-terrestrial research platforms orbiting the earth. All these raw data are then submitted into a computer and using the well-tested, credible mathematical models, scientists calculate the probabilities of happenings of various events. The data we obtain from the research platforms are cross-checked in two different and independent methods and a lot of intercalibrations were done periodically. All these measurements clearly show that the difference in the values of various parameters measured in different methods would always remain within 0.03 degree Celsius, thus the measurements are credible and mostly accurate.

Those scientists who believe in global warming are also aware of the flowing facts:

- The amount of green-house gas released to the atmosphere from the anthropogenic source are less in quantities than those released by the natural sources,
- Water vapour is a far more important component of the green-house gas than carbon di oxide. The distribution of water vapour in the atmosphere is an extremely variable parameter with respect to space and time,
- We still have some equilibrium of heat exchange due to radiation, but radiation can contribute only 25% towards the thermal equilibrium. Evaporation, conduction and convention are the other processes which may ultimately determine the fate of global average temperature. We are not very sure as to how to account for the contributions made by them towards thermal equilibrium. But it is known from thermal physics that if radiation equilibrium is disturbed, thermal equilibrium will be disturbed, resulting in a rise in average temperature of the system. This average change in temperature due to disturbance of radiation equilibrium alone can be very accurately esti-

mated even today. We are in the process of incorporating corrections due to overestimation of average temperature due to local effects. Very complicated models involving convection process are also being attempted and appears to be successful in some of the cases.

Climatology is an interdisciplinary subject. Scientists from various branches and disciplines of sciences have independently predicted, from the ambit of their respective disciplines, the probable consequences of global warming. We may summarise the findings as follows:

- Sea water ingress will inundate the coastal regions, as melting of ice-caps will raise the sea level;
- Draught, heat wave will recur more frequently; this would lead to tensions for water resource management;
- Weather would turn into extreme more frequently. There will be intense flood with vigor hitherto unknown nor encountered;
- As the mean temperature would increase, this would lead to more and more frequent health hazards relating to excessive heat. Diseases for which insects and rodents are the major carrier would increase dramatically. These diseases would spread to those regions of the globe where these diseases were previously unheard of.;
- More and more species would go extinct because they will not be able to cope with these changes. They would go extinct not because of Darwinian principle, but because of early onset of these changes, coupled with anthropogenic factors (like

increased use of pesticides, chemical fertilizers, toxic chemicals, war materials, radioactive dumping etc) as those species will not have enough time to adopt in their species cycle. Because of increase in temperature, more and more species would change their habitat for adaptation, thereby they would alter almost irreversibly the prey-predator relationship in those areas, which would otherwise have remained unaltered.

The Working Group of United Nations, in their Report on Climate Change has clearly indicated that that,

- In the last century, the mean temperature of the surface of the earth has increased by 0.4 to 0.8 degree Celsius.
- Various mathematical models predicted that between 1990 to 2100, the minimum increase in surface temperature of the earth would be 1.4 degree Celsius. It may well go up to 5.8 degree Celsius.
- In the same time frame, the sea level may be raised by 9 to 88 cm.
- There will certainly be an increase in the average rain-fall throughout the globe, but locally and in isolated pockets, there will be progressively decreasing rain-fall and the disparity will increase with the passage of time.
- Natural calamities will increase both in numbers as well as in their intensities.

This working group, while collating and analyzing various findings form various disciplines, and giving due weightages to the alternative explanations had come to the above-mentioned conclusions. If one looks at the core reasons for these predictions from various angles, they seem to converge on a single principal cause for all these changes: rise in the average global temperature. That all the facts and theories which predict the future of climate change have accidentally hit upon a single cause is statistically untenable and has a very low and statistically insignificant probability. Thus we must attach due respect to these observations and act accordingly.

Our Country – The Current Scenario

India is also a member country of the Convention for Climate Change. This membership necessitates that we should have out own country-specific reports regarding the effect of climate change on our country. But before that, many scientists have independently pestering our governments (of various hue) to do something to curb this menace of green-house gases.

In 1995, a Delhi-based NGO, Centre for Science and Environment (famous for the Coca-Cola controversy) organized a seminar on climate change. From a research paper presented in that seminar, we come to know that

- Though by 2050, the mean surface temperature of India would increase by 1 degree Celsius, the same would increase by 2 degree Celsius in North and North-West India. At the same time, during the winter season, the north and the north-west parts of India would be colder by a degree Celsius on the average. In the monsoon, the mean surface temperature of India would certainly be increased by 1 degree Celsius, thereby affecting the current pattern of precipitation to a great extent.

- On the average, the intensity of monsoon will be diminished throughout India, because of reduction in temperature gradient between the earth surface and the sea surface. The combined effect of all these changes will reduce the surface run-offs as well as the available water for flowing through the rivers. We should thus think about a rational water resource management plan to counter this crisis.
- Melting of Himalayan glaciers (we have about 5218 of them) will be accelerated which would result in receding of these glaciers. The Gangotri glacier, during the time from 1977 to 1990 had receded about 368 meters (about a third of a kilometer in just 13 years).

Some of the effects, related to public health, that can be scientifically correlated to global warming had been well documented. The summer of 1994 in the western part of our country was particularly cruel as the mercury rose to a whipping 50 degree Celsius! This has given a field day for those viruses which were happy to have a huge number of hosts. We should not forget that around that time in Surat in western India, we have Plague as epidemic (the same disease has no known incidence for the last half a century or so in any parts of this country), resulting in a death toll exceeding 59, unofficial estimates put the toll to more than 100. In the same year, the western India was reeling under severe flood as a result of unprecedented (and to a great extent unpredicted) rain. Pot holes were full of rain (sweet) water and mosquito breeding was unprecedented. Once again, Surat was the worst victim of another epidemic, this time it was Malaria. In 2003, the severe heat wave sweept Andhra Pradesh, killing 550 individuals; the day temperature rose to 47.5 degree Celsius. 23 districts of Andhra

Pradesh was under the spell of this heat wave. In 2002, Andhra experienced a similar kind of heat wave, the temperature rose to 50 degree Celsius, resulting in a death of 1000 people. Rajasthan and Gujarat were also not spared.

The official report for climate change for our country, prepared by the Ministry of Environment and Forest, which our government has recently (in 2004) sent to the UN is categorical about a few dire observations. The report says that the rain-fall pattern in west and central India is in for a drastic change in the coming decades. Jagatsinghpur and Kendapara districts of Orrisa (we can still remember the devastating cyclone that nearly destroyed these two districts just about 3-4 years back), Nellore and Nagapattam of Tamilnadu (one cannot help by remembers the calamity of tsunami that has visited this parts of the country in the last year) and Porbundar of Gujarat will experience intense cyclone of unprecedented nature, the sole reason being elevated temperature of the land surface. Various parts of the country are already experiencing elevated average day temperature of the land surface as well as relative humidity; this ambience is ideal for outdoor mosquito breeding. This extra load of mosquito cannot be neutralized effectively with existing infrastructure of public health and hygiene. The very recent outbreak of Dengue in Delhi and Maharashtra can act as pointer to such a breakdown of public health system.

After the change of guard in New Delhi, the new Minister of Environment and Forest has finally sent an update of the state of affairs of our country as regards climate change. This update says that by 2050 the entire country will experience an average increase of 2 to 4 degree Celsius, the maximum temperature rise would take place in the northern parts of the country. There will be considerable change in the existing rain-fall pattern throughout the country. In the western and central parts of India, the average rainy days in a year would be diminished by 5 to 10 days or more with a corresponding rise in the average rainy days in the in the year in the east and the north eastern parts of the country by about the same number of days. In other words, the arid parts of the country would become more and more arid, while the wet parts of the country would become more and more wet! The region of our country defined to be Malaria-prone, would be vastly increased, by 2080 the increase would be as high as 10%!

Effect on Agriculture

In our country, about 62% of the cultivable land depends upon rain water for irrigation. Thus any change in the local weather will have severe detrimental effect on our agriculture. The agriculture constitutes about 27% of our GDP; this also constitutes 13-18% of total foreign export. Tata Energy Research Institute (TERI) has estimated that a rise in average temperature by 1.5 degree Celsius would result in a loss of production of paddy by 3 to 15%. Famous economists, like Jyoti and Kirit Pareekh had estimated that if the average temperature of our country is increased by 2.5 degree to 4.9 degree Celsius, then there will be a drop in the production of paddy by 25 to 55% and the GDP would fall by 1.8 to 3.4%. The increase in price of agricultural products would fall by as high as 25%. We may thus conclude that an increase of average temperature of our country just by 2 degree Celsius can ruin our entire economy.

This report also asserts that all the major river basins of our country would dry up to a significant extent, threatening our biodiversity and destroying it to a degree which would possibly beyond redemption. According to a study conducted by TERI, by 2050, the river Bhramhaputra will carry 14% less water than what she is carrying now. The biodiversity in the western parts of India would be worst hit. Rann of Kutchh will be inundated by the ingress of saline water. As a result, at least three species, endemic to this region (who are currently abundantly available) would become rare, if not become extinct altogether. Most probably, a good parts of Mangroves of West Bengal and Gujarat will go under the sea water.

India is endowed with a huge coast line spanning a fantastic 7500 km. National Institute of Oceanography, Goa has conducted a study which has brought to the fore certain dire consequences of global warming for our country. The study says that by 2020, the sea levels in India would rise by 1 to 1.5 meter, thus submerging at least three Metropolitan cities of our country. The three cities are Chennai, Mumbai and Kolkata. If the current trend of increase of average temperature is maintained, then the entire state of Goa would be threatened and to thwart the ingress of sea water, the state of Goa would require a whipping amount of Rs 1100 million! The total stretch of embankment that is required to effectively counter the water ingress for Orissa and West Bengal is simply beyond us, given the time frame left. Thus any increase in sea level would submerge around 1700 square km of land in West Bengal and 2000 sq kn land of Orissa permanently. The total amount required to content this menace for West Bengal would be about Rs 4000 million, while for Mumbai the required amount would be an unbelievable Rs 228700 million (there is no printing mistake here, please read the two training zeros after the significant figures)!

Can We Really Do Something?

The state of affairs is grim no doubt. But the all-o\important question is whether this is just another inevitable natural disaster or we still have some scope for intervention. Some of the measures are known to reverse the trend, but those measures need to be implemented if the entire humankind takes the initiative. But we can easily foresee the difficulties in implementing the measures. In today's world, the hard reality is that we have various nation-states which exist with different political systems pursuing different political economy. Who will bell the cat?

If we can reduce the emission of green-house gases of anthropogenic origin in the atmosphere, then it is only plausible and expected that the atmosphere will regain its own rhythm of heat exchange and equilibrium. This step calls for a drastic reduction, if not a phased out termination of burning of fossil fuel; this step would ensure that we do not release extra load of carbon di oxide, nitrous oxide or methane. Along with this step, we can initiate, on a worldwide scale, the use of smokeless energy sources, energy efficient devices and above all, the concept of conservation is implemented, then we may hope to turn the crisis into a tractable problem.

But once again, can it really happen in the present day nation-state scenario? We already witness various interest groups advocating one or the other avenue to address this impending crisis. The European Union, along with the Oceanian nations teamed up and strongly said that to tackle this problem of global warming, an ecological solution, in the form of switching over from the fossil-fuel energy cycle to renewable fuel energy cycle is the solution. They reject the idea that by improving the efficiency of the fossil-fuel fired devices we may hope to address this problem effectively. They argue that, howsoever an efficient fossil-fuel fired power plant is installed, it is nevertheless, going to emit green-house gases for the coming 30 years or so.

If the EU takes an initiative, the USA is bound to go in the opposite direction. USA in turn, line up those imperialist countries whose economy is dependent upon extracting surplus from the countries of Asia-Africa-Latin America and thus maintain a criminally rich and loathsome life style. Countries like Japan, Canada teamed up with USA to form an "Umbrella Group". This "Umbrella Group" said that the world should not adopt any measure which would adversely affect "economic interests". If the world would have to make a choice between collective peril and "economic interests" of the "Umbrella Group" countries, the world can go to hell and the "economic interests" of the "Umbrella Group" should get the priority. This is typical attitude adopted by the USA since its inception as a nation-state. To safeguard its own economic interests, USA is the only country of the globe, which has used nuclear weapons against peaceful civilian population in Hiroshima and Nagasaki. USA is the only country to use depleted uranium as weapons in two successive aggressions against Iraq and perhaps against Afghanistan. USA is the only country who had walked out of every single international protocols, multilateral agreements and treaties while insisting that every other country should obey them; not only that, one of their main arguments against aggression against Iraq was that Iraq was not "abiding by" the Nuclear Non-Proliferation Treaty and other international protocols!

The amount of green-house gases emitted by the automobile industries in USA alone accounts for twice as much the green-house gases emitted by India, that to all activities generating green-house gases put together. The fuel efficient cars are available in the USA market (the so called 55 miles per gallon cars), but they are relatively expensive. But the government of USA controls most of the oil fields of the oil-rich countries and enjoys a special price, lower than the price we pay. This enables them to offer huge subsidy in fossil-fuel in their domestic market, as a result the consumers do not care about fuel-efficiency and still use 19 mile per gallon cars which has proven polluting effects. In the year 1994, India has released only 3% of the total global green-house in the atmosphere while the corresponding figure for Japan is about 5% (mind you that the total population of India must be a few orders of magnitude that the total population of Japan). The corresponding figure for USA is 20%, about 6.5 times or more than India. Per capita green-house gas emission for an India citizen is just 4% of what is emitted by an ordinary citizen of USA. This same trend continues for the last half of the last century or so. In 1950, USA released a total of 60000 million tones of green-house gases, while India has released 5000 million tones of those gases. The total population of Asia accounts for about half the world population while the total population of the "Umbrella Group" countries is only 15% of the global population, yet they emit green-house gases which is about 3 times more that what is emitted by all Asian countries put together! This is not all. The 122 corporations of USA release 80% of the total anthropogenic carbon di oxide in the atmosphere (incidentally they have 38% direct representation in the US Senate). Just four fossil-fuel companies in the USA account for 10% of the total carbon di oxide release in the atmosphere – mind you this amount is twice the total amount released by India in a year! We may go on adding more and more starling facts.

But despite all these inequalities and blatant violations of democratic rights of the world population on the part of USA, this one country in the entire world is very much adamant in reducing their quota of green-house gases even by a cubic centimeter. They would like to enjoy, illegitimately though, the luxury of 2.75 cars per family of 3.25 on the average. We have some devices which are environment-friendly, less polluting automobiles, we have some amount of scientific as well as technological solutions, but this one country, just to perpetuate its economic and political empire, would now like to put the entire world population for a ransom.

We are not surprised that USA would like to take such a step. A very able developmental economist and supporter and exponent of prevailing economic order of USA, Prof Fred Smith has described the scenario in a very succinct manner. He says in no uncertain terms that the growth of American economy, is squarely related to the increased use of fossil-fuel. Any reduction in usage of fossil fuel would inevitably lead to recession in American economy, more so for the fact that most of the smokeless fuel technologies have been developed in Europe and other countries (i.e., outside USA). Even a reduction of fossil fuel usage by an amount less that one percent in USA can lead to joblessness of a million of managerial cadres and about the same number of miners in the USA. If USA has to adopt the dictum of Kyoto Protocol, then the price of fossil fuel in the domestic market of USA would be increased by 52%, the price of electricity by 86% and the GDP would be reduced by 4.2%. The big corporations (who are the ones behind sabotaging the ratification of Kyoto Protocol) would be forced to accept less and less illegitimate profits; Smith estimates that the corporations may stand to lose anywhere between $27500 million to $39400 million. No wonder that "baby" Bush had very proudly declared before a fully packed US Senate meeting that "Americans are not that idiot to accept it [Kyoto Protocol]!". Who dares to say so!

For us, Indians, the stand adopted by the USA has ominous consequences. We are to assume that the countries belonging to the "Umbrella Group" will not have the appetite to abide by the Kyoto Protocol which they were advocating so enthusiastically for us, and would try their level best to postpone the ratification and then implementation as far as possible. Thus we have to accept the worst possible scenario portrayed by our scientists and economists. Supposing that due to irresponsible emission by the American Multinationals, the average temperature India sores up to 4.6 degree Celsius with its attendant dire economic consequences described elsewhere in this article. But USA will not accept any responsibility for that, it never did in the past.

We thus need to adopt a third principle, quite different from the one advocated by the EU or the "Umbrella Group". We would advocate equity and social justice to overcome this crisis. With equity and social justice can we hope to receive just treatment from those rouge countries as regards scientific, economic and political aspects. From the equitable viewpoint, we would assert that the poor countries must receive the maximum benefit for preserving their own environment, independent of the economic interests of the other two groups. Thus we will get a chance of going ahead with the path of development with eco-friendly as well as old technologies and should be allowed to emit the attendant gases for quite some time (in fact Kyoto Protocol, to some extent advocated just that), the same amount of gas must not be emitted by those countries which have already over fulfilled their quota of emission, as the economic burden will be heavy for the poorer countries.

The so called advanced countries have elaborate arrangements of offering subsidy to the fossil-fuel cycles. The fund for such a bonanza is usually arranged by these plundered countries by not paying the fair prices in the "trade" with poorer countries, by outright plunder, using debt trap and other inhuman techniques perfected by them during the slave trade and direct colony days. With this huge subsidy, they can keep and maintain the fossil-fuel energy cycle as a cheap option. If this subsidy is withdrawn, then only one can compare it with the renewable energy cycle and to see which has a better economic prospect for the future. It may well be possible that they are already at par without the subsidy, as the cost of implements using renewable and generation of renewable are diminishing almost day by day since 1980. (One may remember that in the last Olympic, the entire Olympic city was fuelled by renewable).

But this evidently a tall order. USA has a multi-tier system to halt and thwart any and all attempts to challenge its hegemony. For the USA, they have GATT, WTO and a whole host of bilateral and multilateral organizations, ready to side over and help justifying the misdeeds of USA. But USA is not invincible either. Vietnam was a small country, but forced the USA out from their own soil against heavy odds. Just 50 or so patriots from Cuba ousted USA from the Cuban soil and as of today, they are able to retain their citadel. It is possible to foil USA's schemes to ignore the welfare of the humankind, people have done it before and there is no law which says that this cannot happen in the future!

Cleaner Production for Sustainable Consumption and Waste Minimization

Somnath Narayan

Introduction

The global nature of environmental issues can be seen in many ways. Some important issues facing both industry and the general population are Greenhouse gases, Ozone depletion, Biodiversity loss, Aesthetic amenity, Acid rain, Noise, Environmental accidents, Water, land and air pollution. The main force behind organizing a UN Conference on the Human Environment in Stockholm in 1972 was concern about pollution from modern industry and agriculture in the industrialized country. The Stockholm Declaration at the end of this conference placed pollution at the top of the environmental agenda at the time. Following Stockholm Declaration in 1972, the emphasis was on pollution abatement. Emissions and effluents from industrial sources had to be treated to satisfy certain requirements and standards before being finally released to the environment. Major industrialized countries of the world were reported to be spending billions of dollars on the control of industrial pollution. The situation was becoming progressively more serious as new legislation on the use of chemicals was promulgated in the mid 1970s. One estimate is that over US$ 300 billion was spent world wide each year on environmental projects, most of which was spent on purchasing and maintaining emission and effluent treatment technologies.

The concept of low and non-waste technologies emerged during the later half of the 1970s, which emphasized pollution prevention rather than pollution treatment. In 1989, UNEP's Industry and Environment office in Paris formed a group of experts to work on this paradigm shift. The group finally agreed that there is no absolutely clean technology – **one technology can only be shown to be cleaner than another.** This means that as time goes on there is always scope /chance for improvement in order to develop cleaner and further cleaner technologies and so on. The ultimate aim is to develop a technology which will generate no pollution at all. Cleaner Production is a broad concept which considers many aspects including waste minimization, maximizing resources utilization, minimizing usage of harmful chemicals, maximizing benefit to and from people, minimizing energy use, and minimizing environmental impact. This paper explains the **Cleaner Production concept**, why it is **important**, what are the **benefits**, what are the **barriers to adoption,** how to **implement** a cleaner production program and discusses some of the techniques employed in selected industry sectors. This paper will also highlight cleaner production initiative of Government of India and also case studies on implementation of cleaner production in a few process industries carried out under the World Bank funded projects by the Waste Management Circle formed within National Productivity Council by the Ministry Of Environment & Forests, India.

Cleaner Production Strategy

From the 1960s onwards, it became obvious that the dumping, dilute & disperse strategy was a dangerous although expedient strategy for the populations concerned. Then, pollution control became the answer and a considerable business in environmental technology developed. Sometimes what this meant was simply transferring pollution from one medium to another. Cleaner Production seeks to prevent this misconception of solutions and tries to integrate environmental decisions into business decisions. To see this another way we can look at the direction(Fig I) in which environmental management has moved over the last few decades. The Cleaner Production concept was coined by the United Nations Environment Program (UNEP) in September 1990 in response to a need for a global approach to environmental disturbances, pollution and crises.

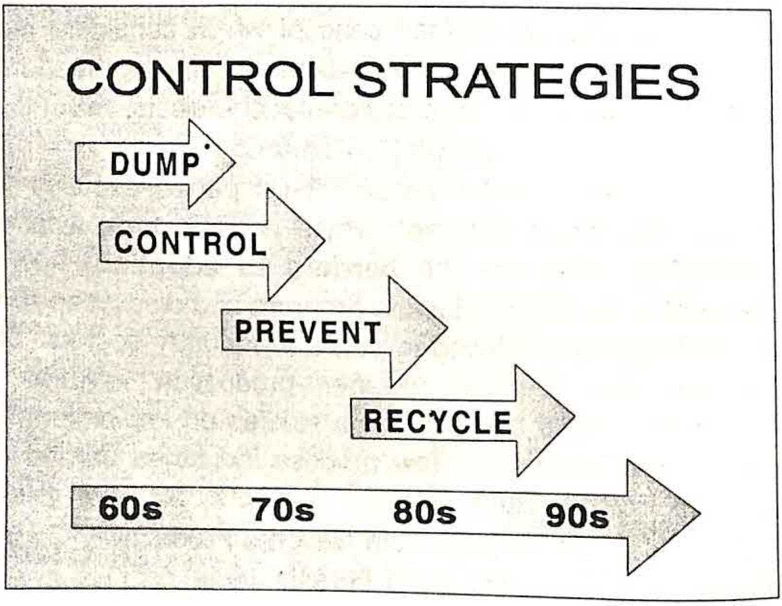


Fig. I

The strategy of cleaner production, as formulated by the UNEP, was launched in 1992 in a conference in Canterbury. The change in attitude became very noticeable during this United Nations Conference on Environment and Development (UNCED). In *Agenda 21*, the UNCED gives high priority to the introduction of Cleaner Production methods and preventative and recycling technologies in order to achieve sustainable development. This priority is emphasized in *Chapters 20, 22* and *30* of Agenda 21. The strategy is now adopted worldwide in the field of environmental management. The UNEP, however, continued to hold meetings (Paris,1990; Canterbury, 1992; Warsaw, 1994; Oxford,1996; Seoul,1998; etc.) to review progress of implementation of cleaner production strategy throughout the world. It is claimed that cleaner production approach in 500 case studies of industries has shown 70 to 100% reduction in air emission, effluent discharge and in production of hazardous and non hazardous solid wastes where the pay back period was ranging from 3 years to 1 year.

Environment policy for industry in India, till recently, had focused mainly on pollution control through end-of-pipe treatment, which itself is wasteful as pollutants are often transferred from one media to another media through various treatment processes. With due recognition to the future raw material and energy scenario, the impact that the industry and its products have on the natural resource and the environmental quality and the necessary thrust being given to the industrial growth in the country, the Ministry of Environment and Forests has formulated comprehensive policies for promoting sustainable development. The policy framework include:

- Prevention of pollution at source
- Encouraging, developing and applying the best available practicable technical solutions

- Conservation of natural resources
- Control of industrial and related pollution with emphasis on reduction and/or, management of wastes.
- Ensuring that polluters pay for the pollution control arrangements.
- Industrial development by using a mix of promotional and regulatory steps.

In all these features, emphasis is on prevention of pollution and conservation of natural resources which will enable India to compete in the international market.

As mentioned earlier, internationally; with a view to minimizing environmental pollution, there are two concepts holding sway at the moment: "clean production" and "cleaner production". In clean production, waste is eliminated by process design at source, generally by replacement of existing toxics in production. In the case of cleaner production, the strategy is to improve existing production systems to minimize generation of wastes. Clean production involves going beyond modification of present processes and the conventional focus on end-of-the Pipe control on emissions.

It may not be possible, considering India's present industrial base, to make the transition to clean production at the present moment. On the other hand, if there is no clear-cut policy of discouraging the setting up of new industries similar to the ones now in existence, no progress would be made down the line even a decade from now, in terms of shifting the industrial base to clean production.

Definition of Cleaner Production

According to the UNEP

Cleaner Production is the continuous application of an integrated preventive environmental strategy to industrial

production processes and products to reduce risks to humans and the environment.

For **production processes**, cleaner production includes conservation of raw materials and energy, elimination of toxic substances in raw materials, and reducing the .toxicity and quantity of all emissions and wastes before a product or an intermediate product leaves a process.

For **products**, the cleaner production strategy emphasizes on reducing impacts along the entire life cycle (cradle to grave) of the product.

For **services**, it incorporates environmental concerns in designing and delivering services.
In other words, Cleaner Production is strategy of continuously reducing pollution and environmental impacts through reduction – that is eliminating waste within the process rather than at the end-of-pipe. However, waste treatment does not fall under the definition of Cleaner Production because it does not prevent the generation of waste although, they remain necessary activities to achieve low environmental impact.. The prevention philosophy of Cleaner Production is the antithesis of the earlier end-of-pipe treatment approach, in which pollution was cleaned up after it had already been generated.

The terms Cleaner Production(CP) and Pollution Prevention (P2) are often used interchangeably. In the case of Cleaner Production and Pollution Prevention, the distinction between the two tends to be geographic – the term Pollution Prevention tends to be used in North America and Canada, while Cleaner Production is used in other parts of the world. Sometimes, Source Reduction and Waste Minimization are also used to mean Cleaner Production. However, philosophically, there is no basic distinction in between these terminologies.

Cleaner Production refers to the production of our goods and services with the minimum environmental impact under present technological and economic limits. It acknowledges that production cannot be perfectly clean. Practical reality ensures that there will be residues of some sort from many processes and obsolete products. However, we can – and must – strive to do better than in the past if our planet is to remain habitable.

Cleaner Production does not deny growth; it merely insists that growth is ecologically sustainable over a longer time span than economists have traditionally used.

Sustainable Industrialization Through Cleaner Production

The production of goods and services without the concurrent production of residues and wastes has long been regarded as an ideal, but something that planners have not taken very seriously. The idea was regarded as uneconomic, and there was always enough empty space to dump unwanted materials. With the passing of time, we have come to appreciate more fully the pressure that pollution puts on our natural resources and our health. Europe, for example, produces more than 2,000 million tonnes of solid waste each year. Twenty million tonnes of this waste is considered to be hazardous.

Traditional methods of dealing with such volumes of wastes have not always been successful, and the resulting contamination of water and land has led to pressure on industry to improve the situation. For factory effluents and emissions, the situation is similar. The environmental impacts are increasingly regarded as unacceptable. The standards are tightening, and disposal costs are increasing. Increased market competition is, in any case, causing companies to make improvements in production efficiency, and generally look for cost-cutting measures. Simple calculations of the market value of chemicals that have been flushed down the drain support the long-standing view of ecologists that emissions, effluents and other residues, in addition to being pollutants, are in fact a wasted resource. In order to escape this impasse, the authorities and industry are now more seriously trying to find a way of avoiding waste production altogether.

We are at last thinking more seriously about producing without waste. We are thinking about ***Cleaner Production***. A model of cleaner production in industries is shown in Figure II below.

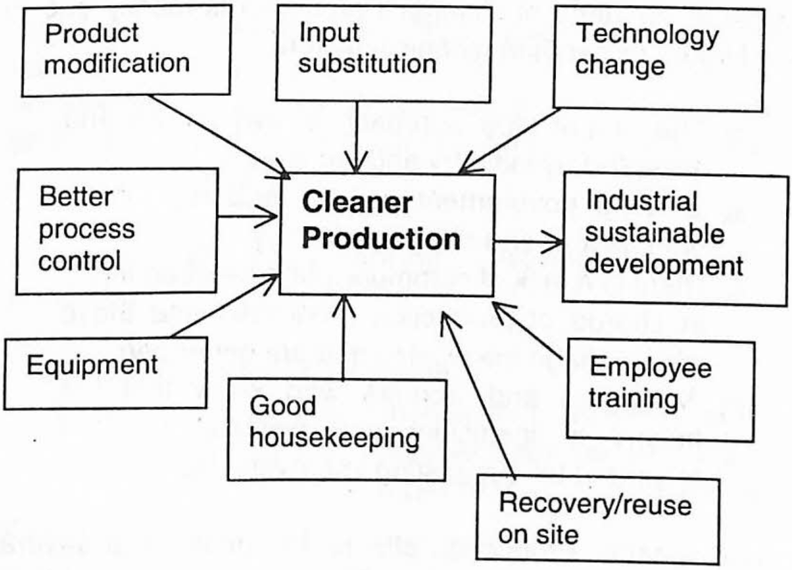


Figure II: Cleaner Production and Industrial sustainable development, Product modification, Input substitution, Technology change, Better process control, Equipment modification, Good housekeeping, Recovery/reuse on site, Employee training.

The economic advantage of Cleaner Production is that it is more cost effective than pollution control. The systematic avoidance of waste and pollutants increases process efficiency and improves product quality. The costs of final treatment and disposal are minimized through pollution prevention at the source.

The environmental advantage of Cleaner Production is that it solves the waste problem at its source. Conventional end-of-pipe treatment often only moves the pollutants from one environmental medium to another.

The slow acceptance of Cleaner Production is mostly due to human factors rather than technical factors.

- The end-of pipe approach is well known and accepted by industry and engineers.
- Existing government policies and regulations often favour end-of-pipe solutions.
- There is a lack of communication between those in charge of production processes and those who manage the wastes that are generated.
- Managers and workers who know that the factory is inefficient and wasteful are not rewarded for suggesting improvements.

Because Cleaner Production attacks the problem at several levels simultaneously, the introduction of a industry/plant level programme requires the commitment of top management and a systematic approach to waste reduction in all aspects of the production process.

As well as achieving a lower level of pollution and environmental risk, Cleaner Production is also often a good business proposition. More efficient use of materials and process optimization results in less waste and lower operating costs. There is often an improvement in worker productivity, with less time lost through illness and accidents. For new processes, such benefits are usually built into the equipment, but even for older plant there is often an economic incentive to modify or change the existing process.

Cleaner Production options can reduce the material, energy, and/or water consumption per unit of product produced, and hence savings are made on the costs of these natural resources. Moreover, amount and pollutant load of the various process waste streams (including solid waste, wastewater, air emissions) is reduced, and hence expenditures for treatment and disposal of waste and emissions are reduced. Most often the efficiency of production processes is increased as well, resulting in higher levels of production output, or improvement of the product quality.

Procedure of Implementing Cleaner Production in Industries

- ***Cleaner Production Program***

A Cleaner Production program in an industry can be started in many ways. The systematic approach outlined below is a useful method as it shows the deliberate and planned nature of the process.

- **Commitment from management**
    - Organize a project team
    - Identify barriers and solutions

- **Cleaner Production Assessment process**
    - Process flow diagram
    - Division into unit operations
    - Analysis of each unit operation

    - designed raw materials and energy inputs
    - actual raw materials and energy inputs
    - designed rates of waste generation
    - actual rates of waste generation
    - causes of wastes
    - potential for savings

- Generation and assessment of options 1:
    - ***Input changes***
- Generation and assessment of options 2:
    - ***Product changes***
- Generation and assessment of options 3:
    - ***Technological Process changes***
- Generation and assessment of options 4:
    - **Technological Process control**
- Generation and assessment of options 5:
    - **Technological Process optimization**
- Generation and assessment of options 6:
    - ***Good House Keeping***
- Generation and assessment of options 7:
    - ***On-Site Reuse***
- Feasibility Study : Technical, Environmental and Economic evaluations

- **Recommendations:** Selection of feasible options
- **Implementation & Continuation**

- **Review and Monitoring**

As can be seen there is a bit of a chicken-and-egg argument in this methodology because the policy comes before the assessment and knowledge of the situation has been gained. However the policy can be adapted fairly readily to any new situation. Some would say that the review phase is an essential first to gain knowledge of the status of the site and then develop the policy based on prior definite knowledge. Some companies never see the need to develop a policy and simply press on with CP assessments and actions. From a theoretical viewpoint, developing a policy is a useful tool, especially for larger organizations as it can embed and foster CP activities and help to promote them.

- **Commitment From Management**

Plant management has to set the stage for Cleaner Production activities, in order to ensure collaboration and participation. Management commitment may be reflected in environmental policy statements. Table II shows past and future model of industrial management towards cleaner production.

Table II

Management model of the past	Management model of the future
• not interested in the environment	• committed to the environment
• day-to-day survival approach	• long term vision
• crisis driven	• proactive
• conservative	• flexible
• strictly hierarchical	• involves all staff in decision making

Employees, in particular those involved in the daily operations and maintenance on the shop-floor, have often key understanding of why wastes and emissions are generated, and are often able to come up with solutions.
It is important in the sense that proper cost information can convince management, as well as employees, that producing cleaner can make money.

- ***Organize a project team***

The project team initiates, co-ordinates and supervises the assessment activities. In order to be effective, the project team should have enough process knowledge to analyze and review the present production practices, enough creativity to develop and evaluate changes for the current production practices, and adequate authority to implement and maintain the proposed changes in the production practices.

- ***Identify barriers and solutions***

The project team should identify the site-specific barriers to Cleaner Production implementation which might exist.

- **Cleaner Production Assessment Process**

The goal of the assessment is to identify and characterize the sources of waste and opportunities for CP, so this is a ***cause generation*** analysis. However it may be appropriate to use more or fewer steps, depending on the needs of the organization where especially size is of critical importance.

In the Assessment Phase, the material balance is studied and appropriate measures are proposed to reduce or prevent loss of materials.

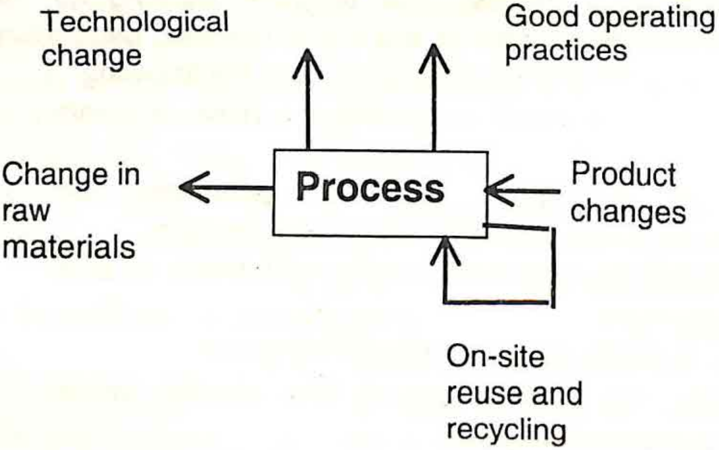
For the ***source identification***, an inventory is made of the material flows, entering and leaving the company with the associated costs. This is known as **Waste Audit .** A waste audit is a thorough account of the wastes from an industry, a plant, a process or a unit operation. A waste audit requires the derivation of a material balance for each scale of operation. The waste audit should result in the identification of wastes, their origin, quantity, composition and their potential for reduction.

This results in a process flow diagram, allowing for the identification of all sources of waste and emission generation. Therefore, a good waste audit should have the following.

- Defines the sources, quantities and types of waste being generated
- Collects information on unit operations, raw materials, products, water usage and wastage.
- Highlights process inefficiencies and areas of poor management
- Helps to set targets for Cleaner Production
- Permits the development of cost-effective waste management strategies
- Raises awareness in the workforce regarding benefits of Cleaner Production
- Increases knowledge of the process
- Helps to improve process efficiencies.

Next is the ***cause diagnosis***. It is an investigation of the factors that influence the volume and composition of the waste and emissions generated. A checklist of possible causes of waste generation is used to assess all possible factors influencing the volume and/or composition of the waste stream or emissions. A material and energy balance is needed for the evaluation of the relative importance of each of the possible waste generation causes.

The next step is ***option generation*** to create a vision on how to eliminate or control each of the causes of waste and emission generation. After Cleaner Production options have been identified, they are evaluated following the same procedure used for evaluation of other investments or technical innovation options. The option generating process then considers each element as shown below.



- ***Change in input materials (Option 1)***

Input material changes accomplish Cleaner Production by reducing or eliminating the hazardous materials that enter the production process. Also, changes in input materials can be made to avoid the generation of hazardous wastes within the production processes.

Input material changes include:

- Material purification
- Material substitution.

- ***Product changes (Option 2)***

Product changes are performed by the manufacturer of a product with the intent of reducing waste resulting from a product's use.

Product changes include:

- Product substitution
- Product conservation
- Changes in product composition.

- ***Technological process change (Option 3)***

Technology changes are oriented toward process and equipment modifications to reduce waste, primarily in a production setting.

Technology changes can range from minor alterations that can be implemented in a matter of days at low cost, to the replacement of processes involving large capital costs.

These include the following:

- Changes in the production process
- Equipment, layout, or piping changes
- Use of automation
- Changes in process conditions – such as flow rates, temperatures, pressures, and residence times.

- ***Technological Process Control (Option 4)***

Better process control is the important tool of achieved CP objectives. Improved process control can also be regarded as part of the prevention practice as "Process optimization". Improved process control is also related to other prevention practices, such as the improved production management, technology modification and equipment improvement or improving skills of the operators.

Improved process control system can achieve the Cleaner Production targets through raw material and energy conservation, product increasing quality and improving process reliability.

☼ *Raw material and energy conservation*

Process control systems provide the control functions to reduce energy and raw material consumption in installations. Some examples can illustrate this. For example process control related to furnaces, boilers and heat exchangers can improve the energy-efficient operation of these unit operations, i.e. less fuel is consumed and less steam is required. Another way of energy-efficient operation is the use of frequency controllers on pumps or compressors. In this way, the equipment can run on the exact required quantities in stead of running at full speed and reducing the amount of transported medium by means of control valves. Furthermore process control systems can help to increase the yield of a product thus minimizing the amount of raw materials and waste product per unit of (end) product.

☼ *Product quality increasing*

Product characteristics, such as constant product quality and high product quality become more and more important from an economic perspective. Process control systems provide the possibilities to run a process uninterrupted according to the same routines. Herewith it is easier to meet constant product specifications. Products with a higher and more constant product quality have a higher added value and generate more revenues, for example through a better customers relation, a lower amount of returned product or longer storage life.

Especially for the pharmaceutical and food industry, product tracking and tracing is more and more demanded to certificate product specifications. Process control systems provide the possibilities to product tracking and tracing. Increased product quality and reliability in relation with (consumer) quality standards can be useful assets for marketing of these products.

☼ *Process reliability improved*

Higher process reliability means less upset conditions and consequently fewer shutdowns. Especially under shutdown conditions product losses and hazardous situations occur. Thus by means of process control the process reliability can be improved leading to less waste material, less raw material and energy consumption, less off spec and re-work of product. For example, production line start, stop and shutdown routines can be implemented in a process control system. These routines guarantee that the installation is started and stopped in the most optimum way, i.e. shortest time and least production losses. Furthermore these routines guaranty that starting and stopping procedures are always executed in a safe way.

☼ *Health and safety assured*

Monitoring and preventive actions on toxic emissions or flammable gasses can raise the health and safety situation for the employees of an enterprise and the community in the vicinity of the enterprise. It is often the case that the hazardous substances in a production process are also causing pollution when emitted or discharged.

Process control system is interconnected with other Cleaner Production tools like improved production management and through training, instruction and incentive schemes.

- *Improved Production Management:*

As the implementation of process control system established, a tighter process control can contribute to an increased efficiency and optimized process, the skills of the management and the employees are improved. Also, not all CP options have to be related to more process control components, in terms of hardware and software. Also the use of an existing process control system, and the use of the data that become available can improve the efficiency of production and economic benefits in a company.

The management team should learn to use and incorporate the (improved) data acquisition in the management system of the company. Subsequently, the management of the company can be improved due to the improved information about the production process and the products. When the company becomes fully automated the work and the required skills of the operators will change and the operators and employees have to be trained for this.

- *Training, instruction and incentive schemes:*

Once the process control of the company has been improved, the employees should be properly trained to use and maintain the equipment and the process and interpret the data that are generated by the process control system. When the process control of a company is improved, the company will probably not become fully automated immediately, but the approach will normally be bottom-up. This can mean that first instruments will be placed, and that the operators might have to register, interpret and act based on the information that the instruments supply. This does imply that new procedures have to be developed.

- ***Technological Process optimization (Option 5)***

Process optimization can be described as the modification of the production equipment and utilities in order to run the process under more optimal conditions, for example through the addition of measuring and control equipment. Optimization of the installation by means of improved process control can lead to higher production figures and/or product quality and subsequently to higher revenues.

Optimization using process control can result in the following:

- Maintaining process parameters to a preset value. When the actual value differs from the preset value, this is always observed by a control system and necessary actions can be taken automatically by the controller and the controlled element can be subsequently adjusted in a controlled way.
- Narrower ranges within a process parameter. The acceptable bandwidth in which the parameter can vary can be made narrower, because the control system can take quick and continuous actions.
- Faster response times to an off set situation. Off set situations, undesired situations in which the process is not running as it should, will be observed immediately (at least in case there are instruments to monitor the required parameters) so action can be taken immediately after such a situation occurs. Without a control systems the operator first has to observe the off set situation before action is taken.

- Reduction of the seriousness of the upset conditions during calamities. Because there can be a quick response to an off set situation and necessary actions can be controlled by the system as well, the possible damage or risks can be prevented or reduced.

So a process control systems can be more reliable, accurate, continuous, faster in response and without mistakes compared to a process controlled manually by operators.
These results from an improved process control again lead to an environmentally more safe and sound production:

- Lower raw material and energy consumption figures that reduce the operational costs;
- More constant and higher product quality;
- Higher process reliability;
- Reduction of potential hazardous circumstances and improved working circumstances.

A process can be optimized by introducing basic or advanced control strategies. Whether advanced control strategies are required depends on the complexity of the process. In practice a process is optimized according to the bottom-up principle, which means that first the process should be optimized by normal control and tuning. If this does not satisfy the required functionality one of the advanced control strategies might be considered. In case of large industrial enterprises having multiple installations, more optimization in operation can be achieved in order to maximize the utilization of an installation.

- ***Good housekeeping (Option 6)***

Good housekeeping implies procedural, administrative, or institutional measures that a company can use to minimize waste. Many of these measures are used in industry largely as

efficiency improvements and good management practices. Good housekeeping practices can often be implemented with little cost. These practices can be implemented in all areas of the plant, including production, maintenance operations, and in raw material and product storage.
Good operating practices include the following:

- Cleaner Production programmes
- Management and personnel practices
- Material handling and inventory practices
- Loss prevention
- Waste segregation
- Cost accounting practices
- Production scheduling.

Management and personnel practices include employee training, incentives and bonuses, and other programmes that encourage employees to conscientiously strive to reduce waste.

Material handling and inventory practices include programmes to reduce loss of input materials due to mishandling, expired shelf life of time-sensitive materials, and proper storage conditions.

Loss prevention minimizes wastes by avoiding leaks from equipment and spills.
Waste segregation practices reduce the volume of hazardous wastes by preventing the mixing of hazardous and nonhazardous wastes.

Cost accounting practices include programmes to allocate waste treatment and disposal costs directly to the department or groups that generate waste, rather than charging these costs to general company overhead accounts. In doing so, the departments or groups that generate the waste become more aware of the effects of their treatment and disposal practices, and have a financial incentive to minimize their waste.

By judicious scheduling of *batch production runs*, the frequency of equipment cleaning and the resulting waste can be reduced. It is at this stage also that the energy efficiency of the process, and of the general plant operation, can be considered.

- ***On-site reuse (Option 7)***

Recycling via use and/or reuse involves the return of a waste material either to the originating process as a substitute for an input material, or to another process as an input material.

- ***Feasibility Studies (Option 8)***

The ***Feasibility studies*** consists of:

✍ **Preliminary Evaluation**
✍ **Technical Evaluation**
✍ **Economic Evaluation**
✍ **Environmental Evaluation**

Preliminary Evaluation

The options are sorted in order to identify additional evaluation needs. Managerial options do not always require a technical evaluation, while equipment-based options do.

Technical Evaluation

Checks on the availability and reliability of equipment, the effect on product quality and productivity, the expected maintenance and utility requirements and the necessary operating and supervising skills. Second, the changes in the technical specifications can be converted into a projected materials balance, reflecting the input and output material flows and energy requirements after implementation of the cleaner production option.

Economic Evaluation

The economic evaluation consists at least of data collection (regarding investments and operational costs, and benefits), choice between evaluation criteria (pay back period. Net Present Value (NPV) or Internal Rate of Return) and feasibility calculations.

Environmental Evaluation

The objective of environmental evaluation is to determine the positive and negative impacts of the option on the environment. An environmental evaluation must take into account the whole life-cycle of a product or service. There are essentially two types of life-cycle analyses: quantitative and qualitative. The quantitative method involves developing a set of criteria against which the environmental impact of a product can be measured and then actually measuring it against these criteria.

- **Recommendations/ Selection of Feasible Options**

A selection is required in case of competing options or in case of limited funds.

- **Implementation And Continuation**

The feasible prevention measures are implemented and provisions taken to ensure the ongoing application of Cleaner Production. The development of such an ongoing programme requires monitoring and evaluation of the results achieved by the implementation of the first group of prevention measures.

To achieve this result, the following tasks should be implemented:

- **Prepare Cleaner Production Plan**
  The measures are organized according to the expected date of implementation.

- **Implement Feasible Cleaner Production Measures**
  The effort needed to implement Cleaner Production measures can vastly differ substantially.

- **Monitor Cleaner Production Progress**
  It can be based on changes in waste (and/or emission) quantities, changes in resource consumption (including energy) or changes in profitability. The evaluation of the monitoring data should include changes in the production output and/or changes in the product mix.

- **Sustain Cleaner Production**
  Integration into the technical development of the company, proper accountability of waste generation, and employee involvement.

Examples of Cleaner Production Techniques in different industries are mentioned in Table I

Table I Examples of Cleaner Production techniques

Change in input material	**Cleaner Production Techniques**
Printing	• Substitute water-based ink for solvent-based ink
Textiles	• Reduce phosphorus in

	wastewater by reducing use of phosphate-containing chemicals
	• Use ultraviolet light instead of biocides in cooling tower
Electronic components	• Replace water-based film-developing system with a dry system
Technological changes	**Cleaner Production Techniques**
Filtration and washing	• Use countercurrent washing
	• Recycle spent wash water
Parts cleaning	• Use mechanical cleaning devices
	• Improve parts draining before and after cleaning
	• Use plastic-bead blasting
Surface coating	Use electrostatic spray-coating system
	• Use powder coating systems
	• Use airless air-assisted spray guns
Good housekeeping	**Cleaner Production Techniques**
	• Reduce raw material and product loss due to leaks, spills, drag-out, and off-specification process solution
	• Schedule production to reduce equipment cleaning - for example, formulate light to dark paints so the vats do not have to be cleaned out between batches
	• Develop employee training

	procedures on waste reduction
Product change	**Cleaner Production Techniques**
Batteries	• Replace mercury in batteries
Spray cans	• Replace volatile chemicals with water soluble formulation as aerosol
Refrigerators	• Replace CFCs with Ammonia
On-site reuse	**Cleaner Production Techniques**
Printing	• Use a vapour-recovery system to recover solvents
Textiles	• Use ultra filtration system to recover dye stuffs from waste water
Tape measures	• Recover nickel-plating solution using an ion-exchange unit

from H.M. Freeman Hazardous Waste Minimization

Initiatives For Implementation Of Cleaner Production by Governments of various Countries

While it is industry that ultimately must implement Cleaner Production, the role of government is to lead by providing an environment that will accelerate the process and encourage industry to initiate its own Cleaner Production programme.

The range of tools available trying to catalyze industry to adopt Cleaner Production is large, and different countries will select those combinations of tools they regard as most suited to their needs.

1. Applying regulations
2. Using economic instruments
3. Providing support measures
4. Obtaining external assistance.

The last tool, obtaining external assistance, is specially relevant to developing countries and those undergoing economic transition. In other words, governments have first established regulations designed to limit emissions to the air, water, and onto the land. They have then introduced economic instruments that encourage the observance of these regulations and penalize their infringement. Finally, they have provided support for industries to enable the regulations to be more easily met. In the process, developed countries have acquired extensive and complicated regulatory systems.

Regulations have not been introduced on such a massive scale in developing countries, and it is not yet clear whether they will need to do so. They certainly do not have to be in place before launching a Cleaner Production programme. The implementation of Cleaner Production, with its goals of zero emissions and full recycling, does not necessarily depend on the existence of an extensive regulatory system. Developing countries may well find it more feasible to depend on raising awareness of the economic benefits implicit in Cleaner Production. Coupled with suitable support measures and the use of external assistance, this will be enough to persuade many industrial leaders to adopt Cleaner Production procedures, with regulations and economic instruments playing a less important role than they have in the industrialized countries.

In order to achieve target of Cleaner Production implementation in industries, international organization like UNIDO has already come forward. To make the Cleaner Production programme a reality and promote the application of Cleaner Production by enterprises in developing and transition countries, the UNIDO in 1994, started to set up National Cleaner Production Centers(NCPCs). Since then, nearly 31 NCPCs and programmes have been established. Of these, ten are fully established and receive no further fund for the programme from UNIDO (Brazil, China, the Czech Republic, Hungary, India, Mexico, Slovakia, Tanzania, Tunisia, Zimbabwe), while the fifteen are still in the process of being built up(Costa Rica, Croatia, El Salvador, Ethiopia, Guatemala, Kenya, Lebanon,, Morocco, Mozambique, Nicaragua, Viet Nam, the Republic of Korea, Sri Lanka and Uganda). Austria and Switzerland are the main donors providing more than half(61%) of the total fund of the Cleaner Production programme. Additional donors are Brazil, Canada the Czech Republic, European Union, Finland, Hungary, Italy, Japan, the Netherlands, Norway, South Korea, Slovenia, Sweden, the UK.The average total annual budget provide to each NCPC is approximately US$ 200,000 to US$ 250,000.

In India, Small and Medium Scale Industries(SMSIs) have formed the backbone of country's economy. There are 3 Million SMSIs in the country as against a mere 2000 industries in the large scale sector. The SMSIs account for over 40% of the industrial production and 30% of the country's export. These SMSIs also contribute towards more than 65% of the industrial waste generated within the country. In India a small enterprise is defined as a company whose total investment in plant and machinery is not more than Rupees 7.5 million. There is no clear cut definition of medium scale enterprises. However units other than some well known larger industries like refinery. fertilizer. petrochemical, automobile (car & truck), multinationals, integrated textile mills. integrated steel mills, wood based pulp & paper mills etc. can be categorized as medium scale enterprises.

The SMSIs in India have no other alternative left till date except adopting the conventional methods of environmental protection i.e. End-of-Pipe (EOP) treatment, since they lack technical skill, lacks of awareness in terms of quality control, inefficient, obsolete and conventional technologies, finances etc. Moreover, they are under constant pressure from the

Regulatory Authorities namely, Pollution Control Boards etc. to meet the emission standards. As discussed in the previous sections, these EOP measures have only alter the form of pollutants and transfer it from one medium to the other. Hence, the EOP offer only a temporary solution to the pollution problem. Also the entrepreneurs view investment in EOP treatment system as a non productive investment as it does not bring economic returns to the industry and therefore industry is not very receptive to it.

However, the benefits of cleaner production / waste minimization have failed to reach the grass root level of Indian Economy - the SMSIs. The main reason cited for this failure is due to lack of awareness and proper guidance on cleaner production / Waste Minimization approach. Furthermore, there are very few SMSIs which can meet the expense of hiring external consultants.

To overcome these bottlenecks and to promote waste minimization /cleaner production concept of Waste Minimization Circle(WMC) has been evolved by Ministry of Environment & Forests, Government of India. A Waste Minimization Circle consists of a small group of entrepreneurs in the small scale industry following similar production process and manufacturing similar products. The group holds regular meetings within the premises of one of the member units and analyses the production process being adopted in the different units. This analysis leads to identification of causes of waste generation and development of WM/CP options through discussions. The group collectively implements the WM/CP options in their respective units, which amounts to increase in individual profitability and overall reduction in pollution load.

A project titled 'Waste Minimization in Small Scale Industries` has been sponsored by Ministry of Environment and Forests and is funded by the World Bank. The project aims to inculcate a culture for Waste Minimization /Cleaner Production Assessment efforts in the Small and Medium Enterprises across the country. This would not only increase their productivity levels making them more competitive in nature but also protect the environment. The objective of the project is to reduce pollution from small scale enterprises while bringing economic benefits to the enterprises, through promotion of group efforts in demonstrating Waste Minimization / Cleaner Production techniques.

To achieve the above objective it is planned to establish and run 100 WMC's amongst the SMSIs. A high level committee has been constituted by MoEF to oversee the overall implementation of the WMC Project and to provide guidance to the Nodal Agency. The committee has representation from :

- Ministry of Environment & Forests (MoEF)
- The World Bank (WB)
- Central Pollution Control Board (CPCB)
- National Productivity Council (NPC)
- National Cleaner Production Centre (NCPC)
- Confederation of Indian Industry (CII)
- Development Commissioner, Small Scale Industries (DCSSI)
- Other organizations

The terms of Reference for the Committee are :

- To oversee the implementation of the project and to provide guidance to the project activities.
- To advise on the modalities on financial transactions in engaging consultants / Consultancy organizations for establishing and running of WMCs.

- To authorize NPC to sub-contract the work of establishment and running of
- WMCs to the selected WMC Facilitators in the identified sectors.
- The Committee shall meet periodically and address various issues that arise during the course of the project and advise the nodal agency for taking appropriate action.

Case studies in five different types of industries successfully achieved by the WMC is appended (ANNEXURE-I to ANNEXURE-V) as reference.

Conclusion

This is a critical time for India to ensure that cleaner production concepts are disseminated rapidly. It is important to note that how many of us is really thinking of cleaner production. Developing countries like India can not afford the green technologies invented in the developed countries in recent times if the developed countries do not have any stake for business in India. It may be kept in mind that it is affordable to import green technology by the third world countries only when a technology becomes obsolete in the developed countries. Moreover, it is neither possible to eliminate 3 million SMSIs throughout the country because large number of workers are involved, nor it is practically feasible to have them switch over to cleaner production options overnight. But at the same time it is also true that any delay in the application of cleaner production will lead to the creation of a technology base that is highly consuming of natural resources and maximizing waste generation. This will increase industry` s impact on the environment because of increase in the quantities of wastes released into the environment.

It is of the utmost necessity to install dedicated cleaner production cell comprising internal as well as external experts in each of the State Pollution Control Board of India for promulgating benefits of the cleaner production concept in industries and also advise cluster wise units in adopting cleaner production options in their production process. However, a very few State pollution Control Boards have already set up Cleaner Production Cells but they are not functioning according to what these are supposed to do. It is important to highlight that Andhra Pradesh Pollution Control Board have already done some commendable job on Cleaner Production in some of the selected process industries of the State. It is also necessary to arrange for foreign grant/loan by the State Governments in order to facilitate selected industries in implementing Cleaner Production. By creating a base of cleaner technologies, it will be less necessary for the country like India to make large investments in systems to treat and dispose off the pollution and wastes.

References

1.'Process Control & Clean Production' – Paper delivered at International Conference on Cleaner production (Sep,2001) in Beijing (China) by Zhou Zhozgfan, Env. Experts for China-The Netherlands Cooperation Projects.

2.` Cleaner Production` by Osama A El-Kholy, Arabian Gulf University, Manama, Bahrain.

3.'WHY CLEANER PRODUCTION?' - A paper by Mr. Peter M. Higgins, retired Assistant Deputy Minister, Conservation and Protection, Environment Canada and Mr. Arthur D. FitzGerald, Consultant to the World Bank and the International Finance Corporation.

4.` Policies and Programs on Pollution Prevention in the United States' by Hongyan He, Civil and Environment Engineering, Stanford University, CA, USA 94305.

5.Related publications of National Productivity Council, Government of India

6.` Hazardous Waste Minimization` by H.M. Freeman; Mc Graw Hill Inc.

7.` Hazardous Waste Management` by Charles A. Wentz ; Mc Graw Hill International Edition.

Annexure I

Case Study
(Cleaner Production in Textile Industry)

M/s. Tirupur Arora is a Textile Processing Pvt. Ltd. company located in Tirupur. The unit engaged in the processing of cotton hosiery, with a processing capacity of about 2500 tons per annum (including printing- 80% and dyeing-20%). This case study outlines the results of the Cleaner production study.

Process Description

The main operations carried out in the unit include:

Fabric pre-treatment

The fabric purification is carried out in the modern soft flow machines as well as conventional winches. Fabric purification is done mainly to remove the oily substances, nitrogenous compounds, waxes and proteins and natural coloring material from the fabric by treating it with hot alkaline liquors containing other required chemicals like wetting agent, defoamer, detergent, stabilizer etc.

Initially machine is filled with required quantity of water after which fabric is loaded. After loading scouring chemicals (water softener, wetting agent, defoamer, NaOH) are added at ambient temperature. The temperature of the liquor is raised by addition of indirect steam. When the temperature reaches 50^0C bleaching chemicals (Hydrogen peroxide and brightening agent) are added. The temperature is then raised to 96^0C and maintained for 40 minutes at the same temperature followed by indirect cooling to 80^0C by fresh water. The spent bleach liquor is discharged along with a fresh water rinse. The fabric is then subjected to 2 hot water washes. Resulting wash water is drained out. In order to remove residual alkalinity the fabric is given acid (acetic acid) treatment in cold conditions. The spent acid liquor is drained out.

As of now slitted fabrics are not being used, hence, the dried fabric is re-rolled and printed on the reverse side of the tubular fabric.

Dyeing

After fabric purification, dyeing is carried out in the same machine. Machine is filled with fresh water. Initially, common salt, anti creasing agent and de-foamer are added. The temperature of the solution is raised to 50^0C. Concentrated dyestuff solution is prepared separately and is added to the liquor over a period of 20 minutes. After Dyes addition, the temperature is raised to 95^0C and is maintained at that temperature for 20 minutes, followed by indirect cooling to 80^0C. At this temperature Soda ash (Dye fixing agent) is added, over a period of 20 minutes. After Soda addition the fabric is kept in motion inside the liquor for 45 minutes at the same temperature. Spent Dye liquor is discharged to the drain. In order to remove residual alkali and the dye stuff, the fabric is subjected to four washes in series, First and third with hot water, second with hot soap solution and final one with acid in ambient condition. Hot water wash is carried out at 70^{0}C for 10 minutes duration while soap wash at 95^{0}C and 15 minutes duration. Wash water from each of these stages is drained out.

After whitening/dyeing the fabric is unload from the machine and is first taken to the Hydro extractor where it is evenly wetted by means of stretching, ballooning by compressed air (and dipping in water containing finishing chemicals in case of final finishing) followed by squeezing between the rollers. The squeezed fabric is then dried in a relax drier. The fabric is then given the uniform width and compacted in layered form in calendaring machine. After calendaring the fabric goes to the roller section in which the compacted layers are put in a roll form. Next it goes to printing or despatch (in case printing is not needed).

Printing

The fabric after bleaching/dyeing is taken for printing. The rotary screen printing machine used in the unit has provision for printing 8 colors simultaneously. The color print paste prepared is fed into the screens from which it is transferred to the fabric fed in. The fabric after print paste transfer is passed through a drying chamber at 145^{0}C. The dried and printed fabric is taken for further processing.

As of now slitted fabrics are not being used, hence, the dried fabric is re-rolled and printed on the reverse side of the tubular fabric.

Finishing

After printing the fabric is subjected to the finishing treatments. The fabric is padded with water containing finishing chemicals followed by squeezing between the rollers. The squeezed fabric is then dried in a relax drier. The fabric is then given the uniform width and compacted in layered form in calendaring machine. After calendaring the fabric goes to the roller section in which the compacted layers are put in a roll form. Next it goes for despatch.

Study Focus Areas

The unit has focused on ways to reduce its pollutant load by optimizing chemical consumption and substituting chemicals which generated lower load. The study outlines the results of the study.

Cleaner Production Opportunities That Reduced Environmental Load and Accuired Economic Benefits

The assessment study evaluated combustion efficiency by monitoring excess oxygen and analyzing input and waste outputs and to evaluate resource loss and conducted literature surveys to identify alternate chemicals . Based on the study CP options were evaluated and the most significant CP opportunities that are implemented are as follows:

1. Reducing the quantity of acid from 1.5 to 1.2 Kg for soft flow and from 2.0 to 1.5 Kg for winch machine. The benefits of this option are :Reduction in acid consumption = 13 tons/annum Savings due to reduced acid consumption = Rs 5,50,000/ per annum (CH_3COOH@ Rs 42/kg)

2. Reduction in use of salt dyeing by 15% has resulted in cost

reduction, along with the reduction in pollution load to the environment.

Reduction in salt consumption = 70 tons/annum Savings due to reduced salt consumption= Rs 2,10,000/ lakhs/annum (Salt @ Rs 3/Kg)

3. Second hot wash water is used in the first hot wash of another machine and the results are Reduction in water consumption = 2500m^3/annum Savings due to reduction in water consumption = Rs 75,000/ per annum (Water @ Rs 30/ m^3)

4. Using last rinse (after dyeing) for scouring liquor preparation has led to reduction in water consumption as well as the corresponding waste water treatment cost. The option has led to a monetary saving of Rs.0.14 million

5. Avoidance/reduction of bleaching agent for those fabric going for darker shades.

Apart from the above, a number of simple housekeeping & equipment modification measures have been identified during the study, which are listed below:

- Providing 5 minutes drag out time after every discharge.
- Reuse of waste water from washing steps (before dyeing) for blanket wash.
- Preparation of preventive maintenance schedule and maintain accordingly
- Recover the print paste by simple piston like device prior to washing
- Modification of fuel firing practices in boilers to optimize combustion and thus reducing in fuel consumption

The overall results achieved of the study are given in the following table.

Sl. No.	Parameter	Before CP (per annum)	After CP (per annum)	% change
1	Acid consumption	57.5 tons	49 tons	-15
2	Salt consumption	440 tons	370 tons	-16
3	Water use	1,88,180 m^3	1,85,600 m^3	-2

Annexure II

Case Study
(Cleaner Production in Distillery Unit – Conversion of Batch Distillery to Continuous Process)

Distilleries may be considered as an allied industry of Sugar industry as it supplies the basic raw material, molasses for alcohol production. Majority of Distilleries in India use molasses as basic raw material.

Most of the distilleries are facing the environmental issue of treatment and disposal of distillery spent wash. Many technologies have been tried for the treatment of spent wash; however none of these methods are found to be effective and economically viable to achieve the standards set by the Pollution Control Boards.

"Composting" technology may be one of the best options. It could result in zero pollution and further compost process can produce valuable organic and inorganic ingredients to enhance soil fertility. However, space becomes a major constraint for adopting this method on long term basis.

M/S S S K Distillery, Akluj is a distillery unit producing alcohol with a production capacity of 30 KLPD.

Considering the problem of treating distillery spent wash to meet the regulatory standards the unit has adopted modified fermentation process namely "DUAL BIOFERMCEN PROCESS" to reduce the quantity of spent wash generation. This change in technology has not only reduced the spent wash generation by 40% but also increased the production capacity by 100%

Process Description

Molasses obtained from sugar industry is fermented by normal yeast to produce alcohol. The sugar in the form of disaccharide in molasses gets converted to alcohol by yeast as per the reaction

$C_6H_{12}O_6$ + Yeast $2CO_2 + 2C_2H_5OH$

100 kg + 48.89 kg + 51.11 kg

(Glucose) (CO_2) (Ethanol)

The factors affecting the fermentation reaction and their effects briefly described below:

Temperature

The optimum temperature of fermentation is 32^0C and the optimum temperature of reproduction for the yeast is 28^0C. The increase in temperature above 32^0C will have a tendency to reduce the fermentation process efficiency, as the yeast cannot handle higher temperatures. Furthermore, it encourages the increase in the growth of Lactobacillus, the principle microorganism that competes with yeast. Lactobacillus consumes glucose to produce lactic acid which is the second major factor affecting the yield of alcohol in fermentation.

Yeast does produce some organic acids during fermentation but their concentrations are relatively low as compared to the concentrations of acids produced by lactobacillus and other contaminating bacteria. When Lactobacillus is achieved, the generation of lactic acid substantially increases the titrable acidity and often these high acid levels will cause the yeast fermentation to reduce or slow down considerably.

Alcohol concentration in fermenter

High alcohol beers have a tendency to reduce fermentation at premature stage. It has been found that when yeast is in the reproductive phase it produces alcohol thirty times faster than the normal rate.

Conventional vs "Dual Biofermen" Process

Alcohol is produced by fermentation of molasses with S Pombe yeast.

In Conventional process only one fermenter is used. As alcohol concentration rises with time the reaction rate is becoming slower and the optimum alcohol concentration that could be achieved was only 7%. In DUAL BIOFERMCEN process two fermenters and a spent wash holding tank are used. This resulted in faster reaction rate in first fermenter and increased alcohol concentration yield i.e 9% in second fermenter.

The alcohol from second fermenter is part pumped to distillation column and part to filter through a strainer to remove yeast cream and recycled for use in first fermenter reducing yeast consumption. The clear fermented wash is collected in the spent wash holding tank and is pumped to distillation column for alcohol recovery.

In this process twenty five percent of spent wash from distillation column is recycled and used for fermentation, thus reduction in equivalent quantity of water utilization and effluent generation is achieved. By adopting reboiler for concentrating spent wash from distillation column another fifteen percent of effluent quantity is reduced. Thus total of forty percent waste minimization is achieved.

Process Benefits

i) High fermentation efficiencies i the range of 89-90%

ii) High ethanol concentration of 8- 8.5% v/v in the fermented wash

iii) 25% spent wash is used for fermentation process which results in less water utilization

iv) Effluent quantity generated is less and hence the cost of treatment of spent wash can be reduced considerably

v) The filler material is wetted with distillery spent wash water and then composted. In batch process the spent wash water generation is high and the requisite amount of filler material is not available. As a result the distillery is being run for 200 days only. With the new process the reduction in spent wash water helped the unit to run the distillery for 300 days i.e through out the year increasing overall profit.

vi) Pre-clarification of molasses is not necessary

vii) The process is simple and economical

viii) Addition of Bakers yeast is not essential like in Batch type plant

Cleaner Production Opportunities That Reduced Environmental load and Accuired Economic Benifits

Capital cost incurred on conversion of Batch type distillery to Dual Process = Rs.70 lakhs

- Benefits due to increased alcohol yield -- Increase in the yield of Alcohol = 1000 lit of Alcohol per day (@10 lit/ton of Molasses) Savings due to increased alcohol yield = Rs.15,00,000 per annum (@Rs.5per lit of alcohol)
- Benefits due to increased production time due to reduced filler for composting : Increase in Profit due to increased production = Rs.15,000/per day (@ Rs.0.25 per liter and 6O KLPD production)
- Thus total increase in profit available =Rs.15,00,000/ annum. (due to 100 more production days)
- Pay back period for the change in process = 2 yrs and months

It can be summarized that conversion of Batch process distillery to Dual process is beneficial not only economically but also from the point of reduction in pollutional load which may be otherwise discharged into environment. The summary of benefits over conventional process are given in the table below:

Parameter	CONVENTIONAL	DUAL BIOFERMCEN
Fermentation efficiency	80-83%	89-90%
Ethanol concentration	7%	8-8.5 % v/v
Spent wash water generation	172 m^3/day	134.5 m^3/day
% spent wash reuse	Nil	25%
Steam used	59.3 T/d	51.9 T/d
Effluent Generation	450 m^3/day	240 m^3/day

Annexure III

Case Study
(Cleaner Production in Paper Mills)

Pulp & Paper industry is governed by the cyclical nature of stocks world wide. With quantitative restrictions lifted and imported pulp available at cheaper prices there is a general recession in the Indian industry and margins are affected. The problems is more acute with small scale industry as they cannot compete on economies of scale. The increasing regulatory pressure to control pollution is further adding to the woes of industry.

M/s Three Star Paper Mills Ltd. (TSPM). situated at Dadri, India is engaged in the production of writing & printing paper (10 to 15 T/day of 48 - 70 gsm) for the past 12 years. The unit is using waste paper as the major raw material (with little portion of imported waste paper).

Process Description

A brief production process of paper manufacturing from the waste paper as adapted in the unit is detailed below.

Waste paper is sorted manually to pick out plastic, wax-coated paper, bitumen etc. and fed into the vertical pulper through conveyor. Water is added for slushing and the whole content is agitated to make pulp from the waste paper. This pulp is then sent to the sand trap for removing the sand. Then the pulp is sent to the potcher/ for de-inking. The pulp is de-inked using caustic and bleached using chlorine, to visual purity. The de-inked pulp is washed with fresh water.

to remove the chlorine and then taken to the decker drum for increasing the consistency of the pulp and subsequently stored in the Chest. The pulp from this chest is pumped through a single disc refiner and stored in the machine chest. Now this pulp goes to a three stage centri-cleaner to remove the knots and other impurities. Alum, rosin and other additives are added at this stage and then it goes to the paper machine.

The paper machine has 3 principal stages

i) The gravitational and vacuum de-watering stage i.e. Wire pit - here pulp is fed at a consistency of around 0.7% and when the paper goes out of this stage the consistency becomes around 20%.

ii) The mechanical de-watering stage. i.e. Press Section - Here the paper with 20%consistency (80% moisture) is squeezed through a set of press rolls (having 2 rolls in each set) to get 35% consistency paper (65% moisture).

iii) Thermal drying stage (indirect steam dryer The final moisture content of the paper rolled on to the pop-reel is around 5- 6%. The paper from the pop-reel goes to the rewinder for making reels in required sizes and then it goes to despatch Section.

Application of CP and The Results Achieved

1. Installation of a waste paper de-duster has resulted into the removal of all the contaminants in the waste paper like, Bidis, Cigarettes, Plastic, Pins, Threads, Mud, Sand etc. which has lead to the improvement of the paper quality, reduction in chemical consumption etc.

Yeast does produce some organic acids during fermentation but their concentrations are relatively low as compared to the concentrations of acids produced by lactobacillus and other contaminating bacteria. When Lactobacillus is achieved, the generation of lactic acid substantially increases the titrable acidity and often these high acid levels will cause the yeast fermentation to reduce or slow down considerably. In-house fabrication of the mechanical de-duster costed about Rs. 10 lakhs and the savings accrued by the implementation of this option is about Rs. 10 lakhs/annum.

2. By installing a hot dispenser, the quality of the paper was

increased and it also reduced chemical consumption for de-inking.

The in-house fabrication of the hot dispenser costing around Rs. 2 lakhs and the savings accrued by this option is Rs. 10 lakhs/annum.

3. The pulper has been changed from vertical to horizontal, high-low type pulper. By implementing this option, plastics are removed as such without getting cut and disturbing the fiber structure. This option has also resulted into the electrical energy reduction by about 20 HP.

This option was implemented with an initial investment of about Rs. 3 lakhs and the savings accrued by this option is about Rs. 5 lakhs/annum.

4. Installation of a Helly screen in place of Couch pit Decker has resulted in the saving of electrical energy. This option was implemented with an initial investment of about Rs. 0.3 lakhs and the savings accrued by this option is about Rs. 1 lakh/annum.

5. Installation of a pneumatic valve (operating at 3-5 psig) at the main header has resulted into the saving of operating man power, steam saving of about 20% and the paper quality was improved due to the regular & controlled supply of steam to the paper machine.

This option was implemented with an initial investment of about Rs.0.3 lakhs and the savings accrued by this option is about Rs. 2 lakhs/annum.

6. Installation of an economiser has resulted in the increase of the Boiler feed water temperature from 35o C to 75o C and

thus the fuel consumption for steam generation was reduced by about 25%.

This option was implemented with an initial investment of about Rs.2 lakhs and the savings accrued by this option is about Rs. 10 lakhs/annum.

7. The diameter of the press roll (top roll) in the mechanical de-watering section of the paper machine was increased to increase the linear load and thereby an additional removal of 4% moisture has been achieved. The implementation of this option has lead to the reduction in the steam required for the drying operation and thus a 20% reduction in the fuel consumption in the boiler.

8. The speed of the paper machine has been increased from the existing level by 20% after providing necessary support in between the beams to arrest the machine vibration. The implementation of this option has increased the production capacity by means of improved capacity utilisation of the plant. Both the options 7 & 8 put together were implemented with an initial investment of about Rs. 2 lakhs and the savings accrued by these two options are about Rs. 6 lakhs/annum.

9. The existing condensate collection tank was provided with a vent. The flash steam coming out of the system was vented out and was not utilised.

This condensate recovery system was improved by connecting another tank on line. The existing tank was used as a flash steam separator and the vent provided in the existing tank was connected directly to the dryers 1, 2, & 3 so as to utilise the flash steam directly. The condensate from the bottom of the tank is collected in the other tank connected to the system and from there the condensate is pumped to the boiler. The implementation of this option has lead to 15% increase in the Boiler feed water temperature and also the consumption of steam was reduced by 10 to 15% because of the utilisation of the flash steam which was vented out earlier. This option was implemented with an initial investment of about Rs. 1.5lakhs and the savings accrued by this option is about Rs. 5 lakhs/annum.

10. By installing a low vacuum box in the wire pit section, the moisture in the paper was reduced by about 2%. This particular option has resulted in the reduction of the press picking by about 1/6th.

This option was implemented with an initial investment of about Rs. 0.5 lakhs and the savings accrued by this option is about Rs. 2 lakhs/annum.

11. Periodic maintenance of the pump glands and installation of the 'Save-All' has resulted into the reduction of the fiber loss and saving of the chemicals which otherwise was drained through leakage in the pump glands.

This option was implemented with an initial investment of about Rs. 10 lakhs and the savings accrued by this option is about Rs. 4 lakhs/annum.

12. Above all, the major option implemented by the unit is the recycle of backwater. By implementation of this option, the fresh water consumption has reduced by about 60%.

This option has lead to the reduction in the electrical energy utilised for the treatment of the wastewater (if it is to be discharged) by about 60%. However, the backwater is clarified, screened and then pumped back to the process which consumes only about 40% of the electrical energy which was required before implementation of this option.

13. Another major option is the manufacture of paperboard (by-product) from the solid waste generated from the

clarification of the wastewater before recycling in the process. The implementation of this option has resulted into the total elimination of the solid waste generated from the manufacture of paper from the waste paper.

This option was implemented with an initial investment of about Rs. 20 lakhs and the savings accrued by this option is about Rs. 40 lakhs/annum.

The Unit has taken enormous efforts for the generation and implementation of CP measures. By adapting the concept of CP, the unit could improve the quality of paper manufactured and reduce its overall cost of production. The over view of total results are given in the table below:

Increase in Production	20%
Reduction in water Consumption	60 m3/T of paper (60%)
Reduction in Fuel Consumption	17%
Reduction in Electrical Energy Consumption	25%

Annexure IV

Case Study (Cleaner Production in Refined Edible Oil & Vanaspati Manufacturing Unit)

This is a case of M/s. Ashwin Vanaspati Industries Ltd., located in Vadodara and engaged in production of vanaspati & edible oil with a production capacity of 60T/day of vanaspati and 30T/day of various types of refined oil.

The unit has identified Cleaner production as a way to reduce their pollution load to ETP and conserve resources. This case study outlines the results of the study under taken by them for soya bean oil.

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Process Description

Edible oil procured from extractors is processed to produce vanaspati and refined oil. The various processes/operations involved are described below in brief.

Degumming

The crude oil contains free fatty acids & gums, it is degummed using phosphoric acid or any other suitable degumming agent.

Neutralisation

After degumming the free fatty acid are neutralised with alkali. The reaction with alkali produces soap stock which is seperated from oil by washing with hot water to remove excess caustic. The soap stock is then seperated and taken to the acid oil recovery section where it is acidified with sulfuric acid to recover acid oil.

Bleaching

The neutralised oil is bleached using activated earth and carbon at an elevated temperature to remove the colour. The bleached oil is filtered using filter press to remove the spent earth and the oil for further processing. Filter press is being cleaned after every batch using steam.

Hydrogenation

The filtered oil is taken in a closed reactor and hydrogen gas is continuously sparged in presence of Nickel catalyst at elevated temperature. This is performed to reduce the content of unsaturated oil.

Excess hydrogen gas is compressed and stored in bullets. It is then recycled to the process. The hydrogenated oil is filtered to remove the spent catalyst, which is recovered and reused.

Post Neutralisation

The filtered mass is again neutralised with caustic lye to remove the free fatty acids formed during the hydrogenation reaction. Soap stock, which is formed as a result of post neutralisation, is sent to acid oil recovery section. The neutralised hydrogenated oil is washed with water for removing any traces of alkali present. The wash water is drained to the ETP.

Post Bleaching

The neutralised mass is further bleached with activated earth and carbon to remove the colour. Then the mass is filtered to remove the spent earth and carbon.

De-odorisation

Odor producing substances are removed in this step with the help of live steam and citric acid under high vacuum & at high temperature..

Final filtration

The de-odorized oil is further filtered in the filter press to remove any fine particles, and then the required vitamins are added in final filtered mass to improve the quality of the product.

Filling and chilling

The product is filled in the tins and is kept in chilling room for 24 hours to produce the required granulating property. The product Vanaspati is also packed in pouches of 1000 ml, 500 ml, 200 mol, 100 ml & 50 ml.

Study Focus Areas

The unit observed that its caustic consumption for removal of fatty acids far exceeds the requirement specified by the quality control department. This excess consumption is not only entailing caustic loss but also oil loss as the excess caustic is saponifying oil other than free fatty acid and excess acid consumption in acid recovery section. And also the unit felt there is a scope for energy conservation in chilling section of vanaspati.To reduce/eliminate the excess consumption the unit as a first step focussed on these areas for CP study.

Cleaner Production on Opportunities That Reduced Environmental Load and Accuired Economic Benefits

The assessment study evaluated causes for higher caustic consumption of caustic and evaluated options for reducing/ controlling caustic use and the associated benefits arising there of. The implementation results were briefly described below.

1. The causes of excess caustic use is found to be due to having no controls to measure caustic dosage and not measuring caustic concentration. Using dip check for caustic consumption in storage tank and dosing caustic by metering pump and manual checking of caustic strength measures were implemented. The benefits resulting there of are:
Investment needed = Rs 15,000
Reduction in caustic consumption = 80 T/annum (flakes)
Savings in Caustic consumption =Rs12.12
lakhs/annum Reduction in acid consumption = 98 T/annum
Savings due to reduced acid consumption = Rs 5 lakhs/annum

2. Regularise the suppliers of raw oil. This ensured the quality of the raw material and the industry stopped using Rice-bran oil which produces large quantities of waste in form of soap-stock and wash-water.

3. Ensuring seperation of soap stock and wash water with little or no free oil from oil by operating the centrifuge at optimum* RPM and regular maintenance of centrifuge yielded following results

Oil saved =50000 liter
Savings in oil = Rs 15 lakhs/annum
Reduction in COD =60 Tons /annum
Savings due to reduction in treatment cost = Rs 6,00,000/ annum
*Optimum RPM for each type of oil should be established

4. Thermostat set point in Ammonia compressor changed from (-)15°C to (-)2°C. Hence electrical consumption in compressor reduced.
This reduces the Green House Gas CO_2 (gas) emission from the power plant.

5. The pouches of vanaspati used to be chilled in chilling room after completing the packing in cardboard cartons. Presently, the pouches are chilled before packing in cartons using plastic trays. This reduces the energy required for chilling & reduced wastage in handling losses. This reduces the Green House Gas CO_2 (gas) emission from the power plant
i) Above solution also saves cartons, which were damaged earlier due to spillage of vanaspati. This reduces the solid waste generated in form of cartons.

ii) The oil spillage, which was earlier not possible to collect, are also collected due to above option and reprocessed. This reduces the solid waste generation

iii) Filter cloth is washed using dilute caustic solution and acid oil is recovered. This improves the washing efficiency of filter cloth

iv) Insulation of all naked & damaged steam pipeline is being done. This will reduce the heat losses to the surroundings and enhance steam saving. This increases the fuel economy thus conserving the fuel for future generation

v) In the batch operation of neutralization, the separation valve size is reduced from 2" to 1 ½" This allows better control for separation of oil from soap stock and reduces the oil loss into the soap stock.

This option was implemented with an initial investment of about Rs. 1.5lakhs and the savings accrued by this option is about Rs. 5 lakhs/annum.

Pollution Status Before and After CP Implementation

The overall comparative results achieved due to this study are given in the following table.

Sl. No.	Parameter	Before CP (per annum)	After CP (per annum)	% change
1.	Caustic consumption	918 T	840	-8.8
2.	COD load	300	240	20
3.	WasteWater treatment cost	Rs 30 Lakh	Rs 25 lakh	-17

Environmental and Occupational Exposure and Women's Health Hazards

Soma Basu

Identifying issues and problems in the **occupational health of women** remains a challenge. Much of women's work remains unrecognized, uncounted and unpaid. Women's work, particularly rural women's in developing countries, has traditionally been carried out within the context of the family. Surprisingly little is known about the health hazards of this environment, in part because women's household work has been under-recorded and undervalued and hence there has been little incentive to examine it in detail. Women's occupations are thus fluid and multi-dimensional. As women move beyond their traditional occupations they meet new health hazards (Women, Health and Environment, Geneva, 2000). The conclusion of a World Bank study of women in India (1996) stated that *'Indian women encounter health hazards in virtually all their occupations'*. In the informal sector, long working hours and unhealthy working conditions were noted. Data that have been collected in this study suggest that a similar statement could be made about occupational health hazards for women across the less developed countries, and that woman in the wealthier nations still face substantial hazards. Hundreds of millions of women throughout the world are employed today in conditions that breed ill health and/or are unsafe. Annually, an estimated 160 million new cases of work-related diseases occur worldwide, including *respiratory and cardiovascular diseases*, *cancer*, *hearing loss*, *musculoskeletal* and *reproductive disorders*, *mental* and *neurological illnesses*. An increasing number of women in industrialized countries complain about psychological stress and overwork. These psychological factors have been found to be strongly associated with sleep disturbance and depression, as well as with elevated risks of cardiovascular diseases, particularly hypertension and greater risk in pregnancy.

According to a WHO report on women's health (1994), occupational diseases develop mainly in women between the ages of 30 and 50, with between 11 and 20 years of work of exposure to the particular hazard. Future rates of cancers, skin diseases, stress-related conditions and diseases of the muscles and joints depend on actions - or neglect. The same report emphasizes the interactive and synergistic nature of health hazards. Thus, poor sanitation, inadequate water supply and garbage disposal, heavy indoor air pollution and crowding create serious and interactive health risks to the poor women. Several studies indicate that indoor and outdoor pollution (both in working place and also at home) contributes to acute respiratory diseases, chronic lung disease, cancer and adverse pregnancy outcomes, and frequency of personal violence. Modern industrialization process with massive destruction of environment turns the situation more and more unhealthy for living. Women – physically and mentally (health) and also economically, are the worst victims under such situation.

With the advancement of human civilization from 'hunter-gathering' society to agricultural and new industrialization era, , destruction of environment is a common phenomenon. Modern agricultural practices and newer technological processes have introduced another kind of destruction. The earth's environment touches every one. Nearly one-fourth of natural resources are spent on commodities that are not essential and some of them are even against the public health. These are super luxury goods, arms and ammunition, drugs and narcotics, etc. Military spending in the past 25 years absorbed more than the total increase of global productivity. Between 1960 and 1985, the worldwide economic output per person grew by 62%, but military outlay grew by 146%. The money obviously comes from depleting natural resources and from enormous increase in national debts. As stated in the 'Histories' (Herodotus, 1928), the classical work of Herodotus, "war violates the order of nature". The histories of wars even since his chronicle of ancient times prove the statement over and over. Military conflicts have a divesting effect on environment from the dawn to this day. The Vietnam War, the Gulf war (1991), The Afghan war and recent Iraq war – all represents the picture of a massive environmental destruction of modern era. Environmental impact of these wars on the atmosphere, sea, wild life, land, etc was tremendous.

Unfortunately, the phenomenal growth in science and technology has not always been friendly to the environment. Military applications of technology, residual of pesticides, radiation hazards are few of them. The sea, the land, and the forest –all the natural resources that serve as a reservoir of life for living are now over exploited. The green house gases, global warming, widening of ozone holes are alarming signs of an impending ecological catastrophe with far-reaching consequences. More development is synonymy to more environmental destruction that leads to more pollution. **'Pollution'** is a term, coined by scientist Odum, in 1971, which means *"the unfavorable alternation of our surroundings and occurs mainly because of the action of man"*. Pollution always causes harmful effect on human health and ultimately on nature and all the living creatures. There is an intimate relationship between environmental pollution and community health. The more the environment is polluted, the more the community health will be disturbed. One of the most important criteria to keep health well is preservation of health of people working in different fields under environmental and occupational exposure.

For the first time 'environment' was put as an agendum of international concern in the Stockholm International Conference in 1972. Within these decades, environmental concern has moved from issue to issue, but no suitable and safe measures that secure women's health are taken. It has been noted particularly that women who are engaged in the struggle for survival are falling victims to the growing ecological crises. Due to the fact that women are actively involved in activities of maintaining life and due to their marginalization in the process of gender division of labour, introduced and aggravated by the development process, women have fallen victims to environmental degradation from time to time. It has been particularly true in the third world countries like India where the gender-based social and cultural responsibilities assign the tasks of collection of fuel, water, fodder and food to women. Women have to interact with nature to a larger extent than others and the worst victims of environmental and occupational hazards. Environmental pollution today is not merely chemical and not confined within the air, water, noise; it is also biological, social and psychological. Again, deprivation of essentials viz. appropriate nutrition, safe and adequate drinking water, pure air, health care, education, employment, the right to safe working and living condition and also human dignity. All these create serious health problems both physically and mentally to women. Women get not only less safe drinking water but the source of such water is not easily and locally available. '*To fetch a pale of water*' they really walk miles after miles under the scorching sun. Under such high temperature and humidity, the hard working may causes some physiological problems to them. There is always a risk to become physically assaulted and raped due to lonely places, while walking. In 2003, a rape case under such situation became a headline of newspaper. Most women do not have enough water for daily needs though they are the only one who brings water in home. Not only in some parts of India but also in our state, violence against women in the family is increasing and *domestic violence* is a common phenomenon for **the water**. There has been a sharp difference in the process of victimization by ecological stress upon women and men. A lot of scientific investigative reports indicated that occurrence of hormonal imbalance within the body under such tremendous stress. Environmental degradation is creating an additional pressure and increasing their workloads since their obligation and responsibilities are remaining unchanged. When natural resources are depleted, much more labour is required by women to maintain the same level of output. Trapped between patriarchy, poverty, gender discrimination and diminishing and increasingly polluted natural resources, it is the poor women who first and foremost pay the price of environmental destruction. In India, women are primary water carriers, managers, and end-user and in this regard, they are in constant contact with water and obviously often it is polluted. So, health hazards are making further impact on women.

Like water - land, traditional and newly invented agricultural system and forest also effects on women's health status. Women are the worst victims of ***indoor pollution***. It has been confirmed from studies that those women and children below five years are among the most affected due to pollutants released during the burning of bio-fuels in traditional stoves.

Several health effects are observed, especially respiratory infections, chronic lung diseases, lung cancer and adverse pregnancy outcomes. **Natural gas** (methane plus impurities and odorant) is the most important source of indoor air pollution responsible for generating illness and is a pollutant chemical that can worsen both classical allergy and chemical sensitivity. A report from the **Environment Health Center, Dallas,** states that out of 50000 patients, 47000 the most important sources of indoor air pollution responsible for generating illness were the gas cook stoves, hot water heaters, and furnaces. Hot water heaters, oil furnaces, gas furnaces, and wood stoves – all the bio-fuels using instruments generated chemically contaminated gases by the burning of fossil fuels. It is crucial to investigate the effect of natural gas exposure in triggering acute environmental illness, asthma and allergies in those presently at risk and, as yet, a symptomatic. In Bengal, the most common 'chulla' (oonun) used for cooking, release the smoke/gases that contain 457.6ug/m^3 SO_2, 118.4 ug/m^3 NO_2, 2018.18 ug/m^3 SPM. **The SO_2 and SPM** (suspended particulate matter) levels are too much high than recommended safe level, according to WHO cause serious health problems. A survey at Delhi in the year 1997 showed that the level of indoor pollution is 50% more among wood stove user than kerosin stove user. Children and women of these family are more suffering different respiratory diseases. The symptoms developed among children are – Common cold, cough, sneezing, Pharynx ache, difficulties in breathing, over production of mucus, dyspnea, and asthma. Blindness, caracts, pulmonary hypertension and cardiac enlargement are very common among women who are constantly exposed in the fossil fuel. **Benzo- a-pyrene, methane, and formaldehyde,** present in wood and cow dung causes serious health problems among rural women. Both of them act directly on hemoglobin of blood and on fetus in case of pregnancy.

Types of fossil fuel	Cooking Time	% of women suffering respiratory symptoms
Wood, Cow dung	4 hours	23%
Kerosin	3 hours	13%
L.P.G	3 hours	8%

Sufficient evidence has accumulated on the negative impact on health of using open flame gas stoves. The **Lancet,** the British medical journal, recently published research findings further supporting this finding, and linking use of fossil fuel appliances to asthma and other respiratory health problems (The Lancet, Vol. 347, Feb 17, 1996, p-426-431.). Increased risk was documented for asthma attacks, waking with shortness of breath, reduced lung function and increased airway obstruction.

Effects of suspended particulate matter (SPM) on health is very significant, as it not only create diseases but also help to change our molecular reaction on genetic level. It mainly causes ENT diseases and serious damage to the lung. These are mainly dust, smoke, soot, lead, ash etc. In the site of stone – crushing (example of Pakaur), the disease 'silicosis' is more common among women. The most harmful particulate pollutant in the smoke from the engines of motor vehicles is lead. It not only damages the brain of the child, but also high concentrations of lead may causes decomposition of hemoglobin of blood. In India, 57% of women are anemic (less hemoglobin related diseases) due to nutritional and different socio-economical background. Pollution, in such a way increases more burdens on their broken health and different complicated diseases are the ultimate result. In house, women are often passes their time in kitchen and inhaled smoke from 'unoon' and also from 'smoking' (cigarette, bidi). It causes serious health problem to them. They are the victims of passive smoking. **Acrolein**, which may exacerbate asthma (according to **American Lung Association of California**), is found in tobacco and wood smoke. It may make women more susceptible to allergies and pregnant women and their fetus both are faced different health problems. Normal growths of different organs of fetus are restored. Many abnormalities are seen after delivery. Premature parturition is common and most of the fetuses are dead. A lot of scientific investigation showed that mentally abnormal baby or physically normal but less IQ, senses are more common in such condition. Research into women and men's occupational health also requires recognition of the extent of intra-sex variations and careful controls for biological and social characteristics that may affect health outcomes. Poor nutrition, for example, may be a more important factor in some types of occupational health impairment than simply being female. The effects of potential occupational hazards on women's reproductive health have been, probably, the major focus of concern in the health of women workers. This concern has increased in recent years as more environmental hazards are identified and as more women enter the paid workforce. A range of occupational reproductive hazards has been documented but a large number of possible risks still require further examination. The classic example of occupational health hazard is 'leukemia' due to radiation of uranium (due to uranium mining) that faced by the people of 'Jadugoda'. Women are the worst victims of this situation as their reproductive health is affected too much and abnormalities in fetus are very common. It is well known after 'Hiroshima' that radiations (α, β, γ rays) cause so many diseases and health problems.

Occupational hazards of household work - domestic accidents are relatively common especially among older women. In developing countries data on domestic accidents are extremely sparse, but it is clear from the nature of the work that here too they are a major risk. Damp and dilapidated houses require extra labour to keep them clean, and dampness appears to be linked to increased levels of asthma, and other respiratory diseases (Hyndman, 1990; McCarthy et al., 1985). Female agricultural workers are subject to hazards that also affect men, such as poisoning from pesticides and chemical fertilizers. They are at high risk for backache, postural defects and infectious and parasitic diseases (Chatterjee, 1991).

Air pollution, at present is a great concern among environmentalist, eco-planner and environment activists. A lot of programs are going on to control air pollution and to minimize the worst effect on health. But, chlorofluorocarbons, greenhouse gases (CO_2, Methane etc.) and many air pollutants that are emitted from the engines of different types of motor vehicles are increased day after day. Though it causes serious health problems among people, but women are the worst effecters of this. Women are more susceptible than men due to their physics and also for some physiological parameters. The fats, oestrogen levels are high in female body and due to this polluted particles more easily accumulated in the female body and also create hormonal disturbances. The hormones - that are not only maintaining the normal health herself but also control the pregnancy and fetus growth. Inhaling continuously polluted air may cause some chronic and serious illness and sometimes even death. **CO_2**, one of the **major air pollutants** reduces the oxygen carrying capacity of hemoglobin of our blood cells. In contact with **NH_3** gas, the eyes, lung may be badly affected. **NO** cause irritation in the fibers of the lungs and in mucous membranes. They are also responsible for digestion and nervous systems. The resistance power of some diseases like influenza may be reduced or completely lost due to continuous exposure. **SO_2** causes an irritation of our eyes, a burning sensation of respiratory tract. It also can create diseases related to ear, nose and throat, pulmonary and also bronchitis, asthma, lung cancer. Another important air pollutant is **H_2S** that causes headache and vomiting tendency, irritation of the eyes, diarrhea and also bronchial asthma.

Socio-economically women are always become victims under our present societal fabrics. For women, health issues and environmental issues are related. Nutritional deficiency, the most common of which is the iron deficiency anemia arising out of frequent pregnancies, childbirth and lactation, where already their nutritional reserve are low. Iodine and vitamin deficiencies compound to nutritional problems together with a systematic neglect of women's health. Early marriage, early and repeated pregnancies and the burden of household responsibilities, all take their toll. Women fall easy victims to various diseases due to ecological erosion and divesting ecosystem and also environmental pollution, **both outdoor and indoor**. Besides this both outdoor and indoor pollution, they also are victims of different **occupational hazards**.

Some occupational-linked diseases attributable to air pollution are also seen in women that cause double adverse effect on their health. We know that smoke or particulate particle, known as pollutant emitted from various sources (indoor also) causes serious health problems. As such, those women who have to remain very close to those sources of pollution or at nearby areas are worst affected by the pollutants. For example, **women who work in stone-grinding factories**, cement industries, or rice mills, have to spend a prolonged period within an environment of dust particles containing silica. This silica enters into the respiratory tract and cause sinus, breathing trouble. This type of factory is very common in rural and urban area. At Paskura (Medinipur district), some parts of

Hoogly, Bandel, and such type of factories are also seen within the premises, where common people lived and also in agricultural field. **Ashes form power plants** are very dangerous to women health. Various scientific reports show how local 'Power Plant' contributes to death and diseases, including premature fetus death, lung cancer and also heart attacks. **(See the website www.cleantheair.org)** Similarly, the workers of textiles mills may be attacked with sinus, pulmonary diseases due to inhalation of fine textile fibres. **Women labourers of building construction** are exposed many dust, gases that easily evaporate from various dyes used for coloring and it may cause harm to the eyes and also causes nervous diseases. **The worker of pesticides** producing industries or the women engaged in spraying the pesticides in agricultural fields or in other places but near to contact to those type of materials may suffer from headache, irritation of eyes, drowsiness, vomiting tendency, stomach ache, etc. It is important to note that pregnant women are more risky than others as they are bearing the fetus. And due to this, women health may pay more attention. Only good health mom give birth healthy baby. A large number of **women workers in various chemical industries** may thus the victims of occupational health hazards, because a quite a number of chemicals produced in these industries may be poisonous to health which emphasizes the need to follow all possible protective measures.

High technology industries also create great health problems among women. A recent article on health and safety in the global **electronics industry**, especially in the *Silicon Valley*, the birthplace of electronics industries, states that women workers suffer great environmental and occupational health problems caused by high technology development. In 1998 (October 5), the Wall Street journal reported that women workers at a National Semiconductor factory in Scotland were suffering from breast cancer that they believe is related to their work with chemicals. Other media reports by the BBC, New York Times, and NBC Dateline have connected the health of workers in electronics manufacturing plants to their chemical exposure. From Glasgow to San Jose, Costa Rica to Malaysia and beyond, these discoveries have profound implications for the **computer industry** globally and also in the United States. People, especially women, also face greater health and safety risks from industrials pollution both on the and in the community. A majority of workers in high tech semi- skilled production jobs, which often involve hazardous chemical handling and exposures, are, mostly women. Women in the job of **X-ray machines** or those working in **radio-therapy units** in hospitals, or in different laboratories may be exposed to the harmful rays and may thus be victims of radioactive pollution. The rays are very harmful as it may change the molecular configuration of some essential molecules in our body and also cause changes in genetic level and lead to mutation. Under such condition, our future generations are in greater threat.

Dioxin forming polyvinyl chloride plastic (**PVC**) released from plastic industries is now another environmental pollution problem that creates a new dimensional health hazards. Throughout its lifecycle PVC plastics release toxic hormones into our food, air and water. Toxic hormones such as dioxin and DEHP are also probable human carcinogens according to the WHO. PVC also releases heavy metals and asbestos into the environment. DEHP is the most widely used and studied plasticizer and 95% of DEHP use is dedicated to PVC production. PVC is the second most widely used plastic. It is used in products ranging from food packaging, toys, furniture, vinyl flooring and building materials. However, safer alternatives such as wood, metal and clay are also widely available. European cities like Berlin and Bonn are already moving away from PVC. Scientist discovers the hormonal action of dioxin that linked deaths to birth defects and cancer. A well-known scientist from German, Theo Colborn, documented the ominous effects of toxic hormones in humans in his book ***'our stolen future'***. Recently *Green peace* called for a total phase out of dioxin forming PVC plastic as it has a dangerous effect on women health. But in West Bengal, there are no such measure is taken to prevent the releasing of dioxin from PVC. At East Kolkata, there are many small factories, where plastic made toys, and different materials from PVC are manufactured. Most of the employees are women and children in such factories as woman labour are cheaper than man. Poverty driven, less educated (due to socio-economical background), women are forced to worked more hours and are directly exposed with such toxic and also carcinogenic elements for a prolonged time, - that ultimately make some adverse effects on their health status.

Conclusion

Due to a rapid growth of population, urbanization and industrialization are taking place in many instances in a somewhat unplanned manner. In the coming days, it will cause more health hazards among us. There is an irreversible environmental crisis within global capitalist society (see also ***American Journal of Sociology*** and ***'Cars and Cities'*** by Paul Sweezy). Although people are aware of importance of sustainable environment, they behave like ecologically illiterate citizen. So, mass awareness about the status of the eco-health right from the grass root level to the top eco-planners is the crying need of the hour. A healthy environment forms the basis for the societies and their people if prospering and enjoying a descent level of development. Growing public awareness brought a halt to some of the destructive spiral environmental problems. It is a moral and ethical issue to try to avoid costly environmental mistakes in future. Only then our long cherished dream of establishing eco-socialism on this *blue planet* could come true.

Economic Instrument to Control Pollution

Biswajit Mukherjee & Dipanjana Maulik

Introduction

Since 1974 a number of Acts and Rules have been enacted for the purpose preventing pollution from different sources and for protection of the environment. The Acts and some of the Rules issued thereunder for the protection of environment and abatement of pollution are as follows:.

1. Water (Prevention & Control of Pollution) Act, 1974 :
2. Water (Prevention & Control of Pollution) Cess Act, 1977
3. Air (Prevention & Control of Pollution) Act, 1981
4. The Environment (Protection) Act, 1986 :
5. Hazardous Waste (Management & Handling) Rules, 1989 :
6. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989.
7. Public Liability Insurance Act, 1991 :
8. Bio-Medical Waste (Management & Handling) Rules, 1998 :
9. The Recycled Plastics Manufacture and Usage Rules, 1999 :

10. Environment (Protection) (Second Amendment) Rules, 1999 regarding standard of fire works.
11. Noise Pollution (Regulation and Control) Rules, 2000.
12. The Municipal Solid Wastes (Management & Handling) Rules, 2000 :

Under the aforementioned Acts a number of punitive measures are mentioned for the defaulting units. The Central Pollution Control Board, the State Government and the State Pollution Control Boards are empowered under the aforementioned Acts to close down the industries and also disconnect their electricity connection. But there are no provisions other than closure or disconnection of electricity to punish the defaulting unit, or filing complaint case before the Judicial Forum to pressurize the industries to erect a pollution control system or impress upon them for taking further action for upgradation of environment which they have already degraded.

The Hon'ble Supreme Court, in dealing with different Public Interest Litigations on environmental matters, has laid down different principles for the purpose of pressurizing the industries to control pollution, and most significant one is 'polluter to pay' principle as a tool of 'Sustainable Development.'

The West Bengal Pollution Control Board experienced that so called closure and disconnection of electricity of the industries also create social problems, because under the law there is no such provision that during closure the industry will pay wages to the workers. After closure, matters relating to non-payment of wages to the workers come up before the State Board and the industry also without erecting pollution control system invites closure enabling them to close down the unit without giving any legitimate financial benefits to the workers as would have been given by them at the time of lay-off, lock-out or closure for their own reason.

Pitfall of Closure

The State Board was faced with various problems consequent on ordering the closure of a unit under the Environment Acts. The units refused to pay wages to the workers during the period of closure.

> M/s. Remington Rand of Howrah is an example in this respect. The West Bengal Pollution Control Board issued a closure order in conformity with the order of the Hon'ble Supreme Court in connection with Matter No. 3727 of 1985 and subsequently, the same was withdrawn. But the said M/s. Remington Rand did not open their unit on the plea that they are not in a position to erect pollution control system and ultimately the factory was closed on environmental reason without giving any financial benefit to the workers which they were entitled to receive from the Management.

Various types of Economic Instruments

Economic Instruments are designed to motivate the industry to comply with the environmental standards by providing a certain financial gain or imposing *undesired* expenditure and penalty. Accordingly, these instruments can be classified into two broad categories.

> **Financial Incentive:** Where achieving environmental compliance is perceived as an opportunity to obtain certain financial assistance or subsidy or reward.

Financial disincentive: Where failure to comply with the environmental standards means having to compensate financially for the degradation caused by the polluting activities

Experience of Economic Instruments in other countries encourages us to explore the scope of the same in the Indian context.

a) Financial Incentive

·Regulatory Compliance ensures the discharge of treated effluents/emissions containing pollutants to the level stipulated in the prescribed standards. Reducing the pollutant content beyond that level can be encouraged by providing financial incentives.

Financial incentive also enables the industries facing serious economic constraints to make investment for pollution prevention.

- The West Bengal Pollution Control Board has initiated programmes for financial and non-financial incentives. It has instituted awards for excellence in maintaining environmental standards. Besides, the award winning units are subject to less frequent inspections and are thus able to save the cost of laboratory tests. Financial and technical assistance is provided to the small scale industries which were operating small coal fired boilers or coal fired ceramic kiln in Kolkata metropolis through a collaborative project of the West Bengal Pollution Control Board and India-Canada Environment Facility Project, new Delhi.

- The State Government introduced a scheme called "The West Bengal Incentive Scheme, 2000" for industrial projects of large medium and small scale units of the state. Under this scheme a small scale unit may obtain subsidy up to the ceiling of Rupees five lakh for installation of pollution control equipment.

Financial incentive schemes are often applicable to motivate industries to go beyond compliance.

b) Financial disincentives

Pollution fines, pollution charges are devised as penal action for the industries, which violate environment regulations. However, Indian legislation generally does not provide for fines (except in the Water Cess Act, 1976 which levies a higher charge for units which do not comply with the standards.)

- Pollution charges are often estimated on the basis of damage cost or social cost.
- Estimation of damage cost or social cost agreeable to all parties is a difficult task in absence of clear benchmarked methodology.

A new instrument

A new instrument, namely, the Bank Guarantee system has been developed and implemented by the West Bengal Pollution Control Board.

•Bank Guarantee System

Under this system, a unit is given a specified period to come into compliance with the standards and asked to execute a bank guarantee for the purpose. In case of failure to achieve standards, the bank guarantee is forfeited.

The Bank Guarantee System has evolved from practical experience in curbing industrial pollution. Bank Guarantee is imposed on an industry when it is evident from regular monitoring that the industry is persistently failing to meet the standards. The industry is directed to submit a time bound action plan for upgradation of its pollution control system and a bank guarantee of a stipulated amount for implementing the action plan. The time period is fixed strictly on the basis of technical feasibility. The Bank Guarantee amount is estimated in such a manner that it becomes a financial deterrent for a industry. If the industry fails to comply with the standard imposed within the stipulated time, the Bank Guarantee is forfeited. This system has two components.

a)The possibility of imposition of a Bank guarantee (as also other punitive measures prescribed under the law) poses a threat to the unit and discourages it from violating the regulators' norms

b)When Bank Guarantee is imposed, unlike pollution charges it drives the industry to meet the standard as soon as possible in order to obtain the release of Bank Guarantee and save the bank charges.

Further, in case the bank guarantee is forfeited, money may be used in environmental restoration work.

The West Bengal experience indicates the Bank Guarantee system works well in moving the industries towards compliance. The Bank Guarantee system thus becomes a very effective third instrument.

Judicial Concurrence of Bank Guarantee System

This system of imposition of Bank Guarantee came up before the Judicial scrutiny and Hon'ble Calcutta High Court in connection with Matter No. W. P. 5938 (W) of 2000. The State Board issued a number directives including imposition of bank guarantee, followed by a closure order against M/s Enpee Wires Pvt. Ltd. The industry is engaged in galvanizing operation within Kolkata Metropolitan Area. The industry contested against the State Board's order in the High Court. .In the judgement it was mentioned that the Hon'ble High Court has gone through the matter and found that:

- Since 1997 the West Bengal Pollution Control Board has pursued the unit to install pollution control devices.
- The industry was directed to submit a Bank Guarantee of Rs. 100000 to ensure the timely compliance.
- The industry has not furnished the bank guarantee. It has also failed to comply with other directives of the State Board.

The Hon'ble High Court noted that the State Board issued closure to the industry due to such state of noncompliance. The Hon'ble High Court thus notionally endorsed the State Boards' policy for imposing Bank Guarantee for pollution control.

The West Bengal Pollution Control Board imposed Bank Guarantee even upon the Central and State Government institutions for timely installation of the pollution control system. Subsequently, the State Board also used this instrument to force the industries for taking appropriate steps for restoration of land or the area which the industry degraded by their discharged effluents.

The case of M/s. Ramswaroop Industry, Kalyani is also a example in this matter. This industry is a medium size galvanizing unit. This unit discharged their effluent outside the factory without any treatment. The untreated effluent damaged the surrounding land. The State Board imposed Bank Guarantee of Rs.2 lakh, with a condition that the unit should take all effective steps for restoration of the land with a specific time schedule. Subsequently, the industry complied with the order of the State Board on the face of such punitive action.

The Appellate Authority constituted under the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 has also accepted the Bank Guarantee system, It has also used this instrument on its own. Some important cases are as follows:

i.The West Bengal Pollution Control Board imposed a Bank Guarantee upon the Seth Chemical Works, Howrah to the tune of Rs. 10 lakh and after considering the prayer of the appellant unit, the Appellate Authority reduced the Bank Guarantee amount to Rs. 6 lakh, but in principle accepted that Bank Guarantee is a most important instrument to force the industry to erect pollution control system without exhausting the provision of Section 5 of Environment (Protection) Act, 1986 or Section 31A of the Water (Prevention & Control of Pollution) Act, 1974 or Section 33A of Air (Prevention & Control of Pollution) Act, 1981 wherein The West Bengal

Pollution Control Board is empowered to order closure and disconnection of electricity

ii. The West Bengal Pollution Control Board directed an industry, namely, M/s. Finlay Industries Private Limited, Howrah to execute a Bank Guarantee for erection of pollution control system as it had received a serious public complaint against this unit. The unit approached the Appellate Authority, who after hearing, confirmed the order of the West Bengal Pollution Contro Board and the Bank Guarantee was not released till the unit took appropriate steps to reduce the pollution load and mitigate the problem in the public interest. In this order the Appellate Authority indicated clearly that the pollution control system must be utilized fully in order to maintain both out-door and in-door environment free from pollution. The industry manufactured glasswool and it would be their responsibility to curb adverse effects of fugitive emission in both out-door and in-door environment of the factory. The Appellate Authority, while giving verdict, was in favour of imposing Bank Guarantee instead of closing down the unit, to force the industry to make the pollution control system functional.

iii. The West Bengal Pollution Control Board imposed Bank Guarantee of Rs. 10 lakh upon a stone-crushing unit at Jhargram, Midnapore(W) for the purpose of forcing the industry to adopt proper pollution control system. Subsequently, the order of the West Bengal Pollution Control Board was challenged before the Appellate Authority and the Appellate Authority upheld the order of the West

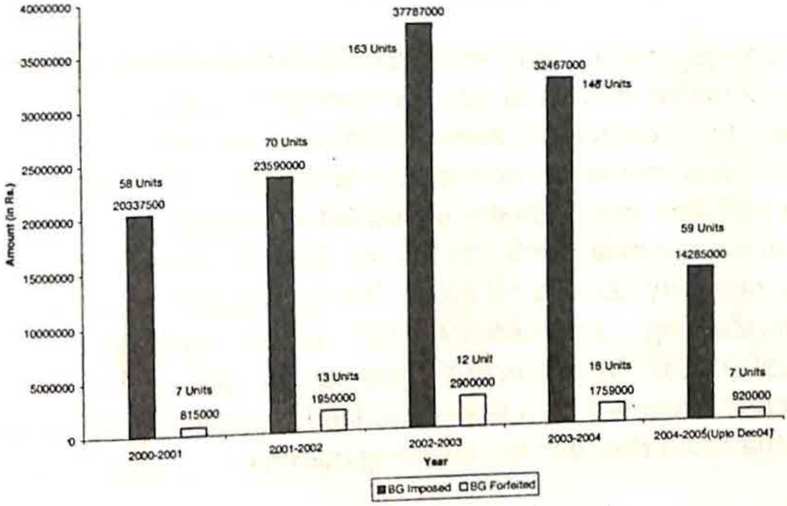
Bengal Pollution Control Board and directed that the Bank Guarantee amount of Rs. 10 lakh would remain in tact with the State Board, not only for the purpose of forcing the industry to erect pollution control system, but also to force the industries to make some benevolent work for the tribal people whose land was taken by the unit for the purpose of quarry and for establishing stone crushing unit, without giving the adequate compensation. The Bank Guarantee system has become a useful instrument. The Bank Guarantee system has been accepted by the Hon'ble High Court through its judgement dated 25-05-2000 (W. P. No. 5938 (W) of 2000) and subsequently the Appellate Authority also widely used this system for reasons narrated above.

The Central Government has also introduced this Bank Guarantee System through a Notification for the purpose of forcing the brickfields to erect pollution control systems in a specific time schedule.

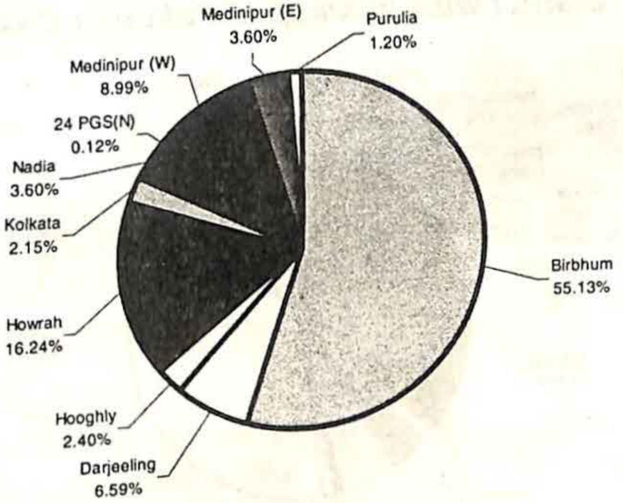
The figure showing the number of cases where Bank Guarantee is imposed by the West Bengal Pollution Control Board.

It shows that while the number of orders imposing Bank Guarantee has increased, the number of cases where the Bank Guarantee guarantee has been forfeited has relatively or even in absolute terms decreased. It indicates the effectiveness of the instrument.

Status of Bank Guarantee



Districtwise Breakup of Bank Guarantee

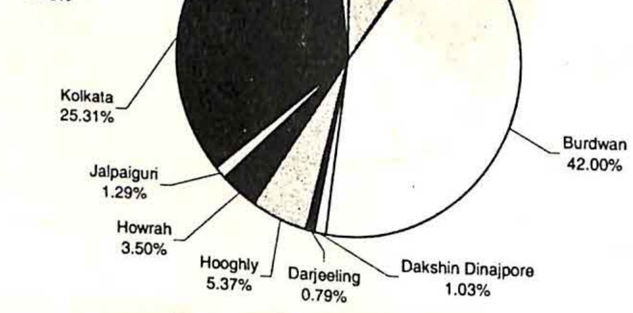


Pollution Cost

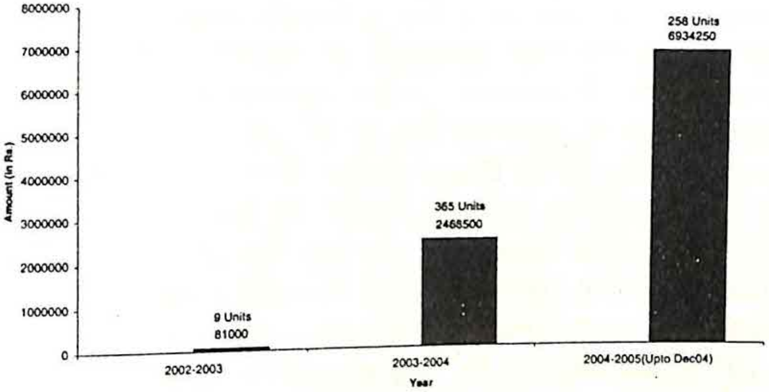
Like Bank Guarantee State Board also introduced another economic instrument to realize the damage cost from the industries by way of imposition of cost in conformity of the principle laid down by the Hon'ble Supreme Court in its solemn order in respect of `polluter to pay principle'.

Hon'ble Supreme Court emphatically explained that `polluter to pay principle' means to pay the damage cost by the industries which the industry has already damaged by way of its violation of the environmental norms. But at the time of submission of the pollution cost industry supposed to ensure its compliance of environmental norms in future. Industry cannot ignore its responsibility as laid down in the constitution in respect of safeguarding environment for future generation. For `Sustainable Development' `polluter to pay principle' has already accepted as a law of the land. Pollution Cost imposed by the State Board in the following manner :-

District wise breakup of Pollution Cost



Status of Pollution Cost



Impact of Bank Guarantee and imposition of pollution costs

It appears from the Bank Guarantee figures that since the financial years 2001 to 2005 441 nos. of units timely erected pollution control systems and, therefore, no closure or any other regulatory measures as envisaged under `Command and Control' Policy of State Board are required to implement the same upon the units. Closure means unemployment of labour for a certain period. The main intention of the State Board is to encourage the units to erect pollution control systems and issuance of closure against any unit on environmental reasons is the last resort, but not the solitary way.

Even after timely completion of pollution control systems by the units another problem may crop up as some industries may not regularly operate the pollution control system to save the energy cost and the operational costs for making more profits. This trend might spoil all the efforts of the State Board officers to protect the environment. The State Board officials have also to opt for night patrol to check whether pollution control systems are functional or not. Because, otherwise this practice of not operating the pollution control system may become very common amongst of the industries. The non-functioning of the pollution control systems leads to series of environmental degradation comes in different places. To bar this activity the State Board started imposing pollution costs upon the defaulting units in conformity with the order of the Hon'ble Supreme Court. For the last few years State Board imposed pollution costs upon the different industries and after collection of such pollution costs the same was distributed to the concerned districts for upgradation of the environment by way of development of social forestry, rain water harvesting, development of Eco Parks and development of general awareness among the people. Public Grievance Cell of the State Board is also functioning with its limited resources In fact; the people living in the surroundings of the industries are the best persons to monitor the functioning of the pollution control systems. and to collect information from the affected persons..

Imposition of pollution costs has brought in slight changes in the attitudes of the industries. The *per day* pollution costs strike the industries substantially from the financial angle. In the marketing economy, the economic instruments have already been recognized as one of the sharp weapons for controlling pollution in different countries and in West Bengal, use of this economic weapons is definitely encouraging and forcing the industries to comply with the different environmental norms in a befitting manner.

It is no denying fact that `Command and Control' Policy as reflected through closure and filing of complaint cases in judicial forums has a strong supportive element. However the economic instrument can complement the `Command and

Control' Policy in a effective manner. Judicious use of `Command and Control' Policy along with use of economic instrument improves the administrative system for implementing different environmental norms.

The proper implementation of law depends on a disciplined administration, active judicial system and social consciousness. Mere enactment of laws does not suffice to serve their purpose. What is needed simultaneously is a mass consciousness regarding the necessity and use of law. Legally the `Sati' system was abolished long ago. Yet even today widows are burnt alive on cremation pyres in the name of `Sati'. Administration stands a silent witness. Rejoicing in the resurvival of Sati, its supporters distribute sweets amongst themselves. Similarly, laws passed for the protection of the environment will never be properly implemented until the masses become conscious of the necessity of protecting nature. However the responsibility of creating such a consciousness by national efforts and legal compulsion remains absolutely essential. In the present times quite a few important decisions have been taken by the Indian Judicial system. The highest seat of Judgement in India, the Supreme Court in deciding a case has stated that every man has the basic claim to a healthy, pollution-free environment in which he can live.

In our country, correct implementation of laws for the prevention of pollution coupled with a social movement alone can give the next generation a pollution free society. The only other path points to an unknown, uncertain darkness which equals death in its monstrosity.

In summing up, brings us back to square one. The responsibility is ours, the power and means are in our hands, the world is ours and its all upto us either to face perils or to boldly assert survival for the human race echoing the familiar song :

Live on, the Earth !
And you, earthfold, take this into your head :
We shall have not another Earth
    If this one were dead.
Of a thousand planets no loved one like it
Of a thousand planets none so green and so sweet
    So live on, the Earth !
Live on !

Panacea to Public Complaints

Avanti Roy & Surya Mukherjee

Without having to spend money or hire a lawyer to plead the case, the quasi-judicial public grievance system of the WBPCB redresses public complaints in no time.

- Mrs. Ghosh of Maghugarh, Kolkata filed a complaint against pollution from illegal cowshed in her locality. Prompt action was taken and an official order helped remove the cowshed from the area.
- A senior citizen from Asansol complained against the operation of Diesel Generator (DG) Sets, the noise generated from which had an adverse impact on his health. The WBPCB passed an order directing the persons concerned to remove the DG Sets.
- Complaints against brick fields causing damages to the agricultural land endangering the livelihood of village people. Intervention of Board brought relief.
- Complaint from German Consulate General against a construction company sorted out by the State Board stopping the unauthorized construction during night hours.

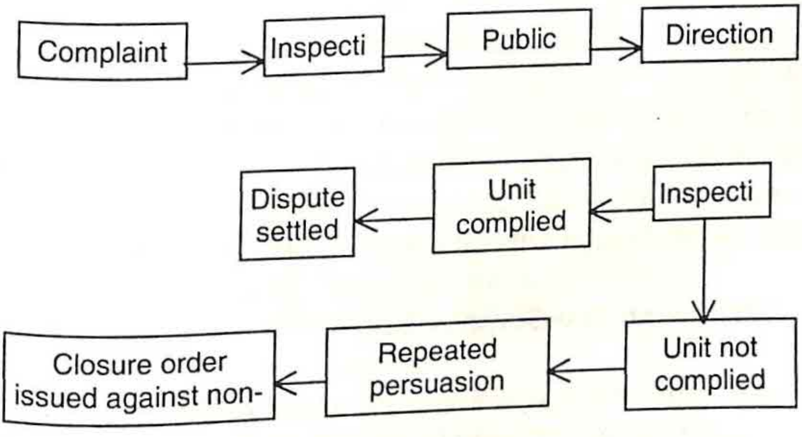
- Complaint against construction of a multi-storied building in Gouribari area by evicting the birds from their nests. State Board intervened in the matter and gave relief to the bird lover, in maintaining the scarce species of birds.
- Fishermens' complaints against cable operators for laying cable in the rivers putting hindrance in catching fish.State Board, after hearing of both the parties and Kolkata Port Trust resolve the issue.
- Filling up of `Surer Math', a vast wetland, in Dum Dum was stopped by the State Board to prevent degradation of environment.
- Khayer Bagan, a mango orchard near Mankundu (Dist: Hooghly), has been saved by the State Board through strong persuasion,

Cases like these are a common phenomenon at the West Bengal Pollution Control Board (WBPCB). Working on a quasi-judicial mode, the WBPCB follows a transparent public grievance procedure that makes the system of redressing public indictments faster and more efficient.

The WBPCB Public Grievance System: Lending An Ear to Public Complaints

At the backdrop, the Government of India had introduced the doctrine of 'public grievance' where it was made mandatory for all government departments with public interface to have functional public grievance cells. In order to carry this out effectively, the West Bengal Pollution Control Board (WBPCB) started a public grievance cell comprising a retired judge, the Board's legal officer and other technical officers. Ever since it started functioning in 1994, the WBPCB public grievance cell has received 16000 complaints and disposed 86 per cent of such cases within a short time frame.

Public hearing is a transparent method adopted by the WBPCB for resolving the public problems related to environmental issues. The WBPCB hearing authority is composed of a retired Judicial Magistrate and other legal and technical officers of the Board. After careful consideration of the representations from both the complainant and the aggrieved, necessary directions are issued. If the directions are complied with within a time schedule, the case is disposed off. Otherwise, legal actions are taken against the errant unit during subsequent hearings. In the ultimate case, closure order is issued until the unit adopts an adequate precautionary arrangement for control of pollution. In case the complaint is found to be beyond the legal jurisdiction of the Board, necessary suggestion letters or letters of direction are immediately sent to the concerned authorities. This process is diagrammatically represented below.



Following the general practice, the public lodges pollution-related complaints by directly approaching the office of the Board. Recently, the process of lodging a complaint at the WBPCB was made simple. One can now lodge a complaint by just clicking **www. emis. wbpcb. gov. in** and submitting the necessary information related to the complaint. Almost immediately, the complaints are acknowledged, inquired, inspected and subsequently redressed during a hearing in presence of both the parties involved. The Board punishes the defaulters with bank guarantees as well as with notices of disconnection of electricity and closure.

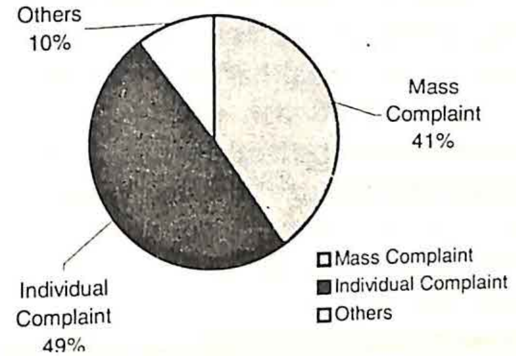
The basic essence of the WBPCB Public Grievance System is to provide 'solutions' to the public who lodges complaints on pollution problems faced by them. The number and nature of the complaints received by the WBPCB, however, also acts as an indicator and speak volumes about the environmental scenario of the state. For instance, a trend analysis of the complaints shows that more than 50 per cent of the complaints are related to air pollution. This gives a clear indication that effective steps need to be taken towards the implementation of the Air (Prevention and Control of Pollution) Act, 1981 in the state.

The growing number of public grievances is also indicative of how people are getting increasingly aware about the environmental challenges we all face. People now realise that industrial units and other pollution sources that are responsible for water, air and noise pollution also pose danger to their well being due to negligence and irresponsible functioning.

Understanding The Complaints

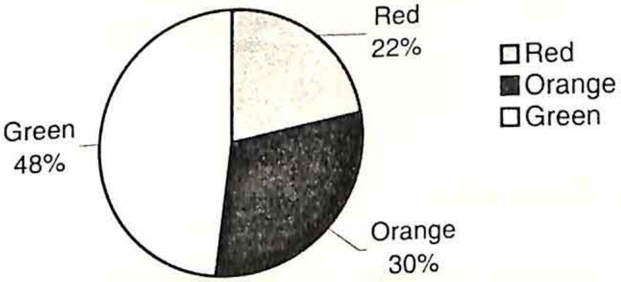
Besides providing a remedy to individual grievances, the cell admits community complaints as well as those forwarded by government bodies including municipalities and various other organisations. Recent statistics reveal that individual complaints received are 29 per cent as compared to a staggering 71 per cent complaints received from aggrieved groups.

Summary of Mass/Indiividual Complaints received



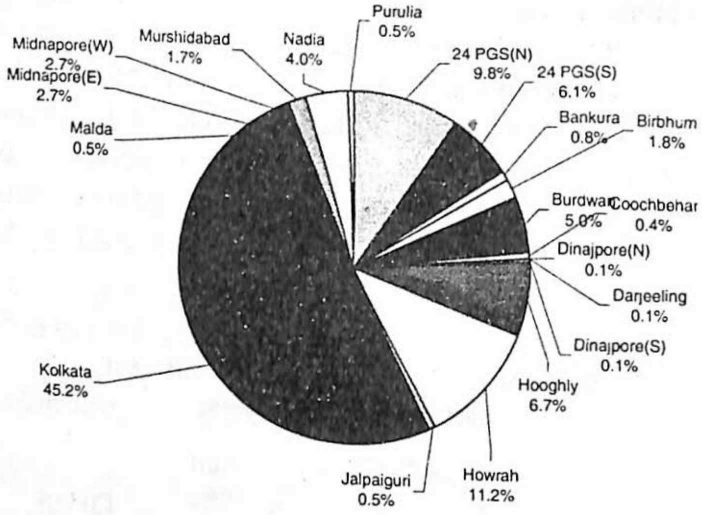
Complaints against the orange category of industries, the units with moderate pollution potential is 30 per cent and half the complaints received are against the green category, the ones that pollute the least. In addition, about 20 per cent of the complaints are against the maximum pollution potential bearing-'red industries' that includes chemical, electroplating, ETP sludge dumping, bleaching & dyeing, acid lead battery and others.

Summary of Complaints against different categories of industries



Also, about 45 per cent of the complaints come from Kolkata followed by 11.2 per cent being received from Howrah; a fair percentage pouring in from other districts. The nature of complaints, however, acts as an indicator of the current environmental problems. Studies reveal that air pollution is the topmost problem as almost half of the complaints lodged are against air pollution. Further, while 36.55 per cent of the problems are related to both noise and air pollution, 11.11 per cent are exclusively related to noise pollution.

Districtwise Distribution of Complaints during 2003-2004

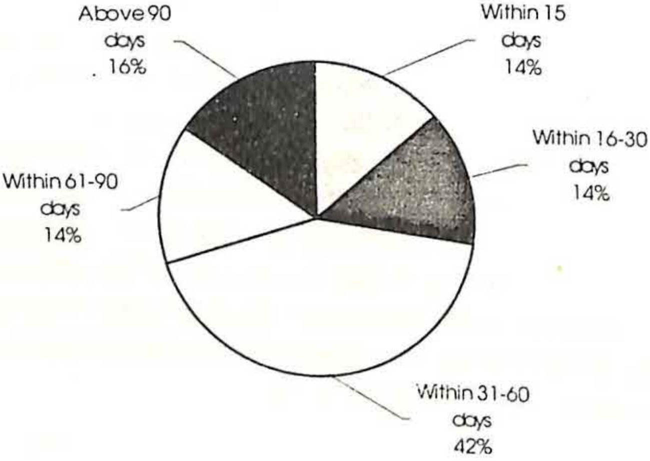


Special Complaints

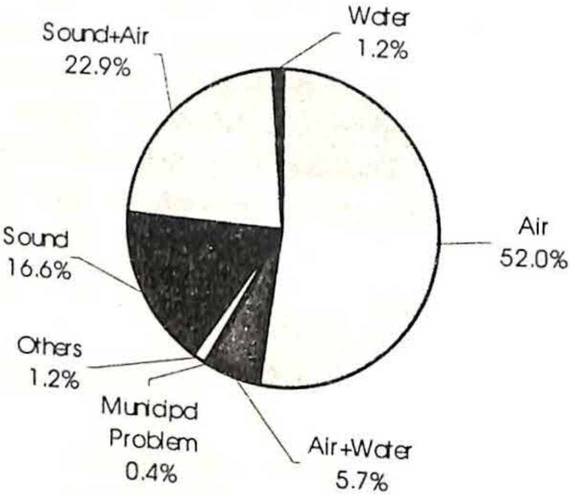
Decibel disputes, however, are predominant during the festive days: Durga Puja, Kali Puja and Diwali. During these festive occasions, the Board sets up special Control Rooms for receiving public complaints related to noise pollution. According to the public complaints received and checks done by the WBPCB officials during these days, it was observed that some Puja organisers and municipalities have not adhered to the specified norms □ non-attachment of sound limiters, violation of time schedule, non-compliance of the noise level standards and idol immersion norms □ to name a few. Consequently, 53 Puja organisers were called for hearing and actions were taken against the defaulters □ specific cases were taken to the High Court, some were given an undertaking for using sound limiters in the future and a few others had to pay the pollution costs. More than Rs.4,00,000/- was collected as fines that would be used for improvement of the environmental condition of the area.

Synopsis

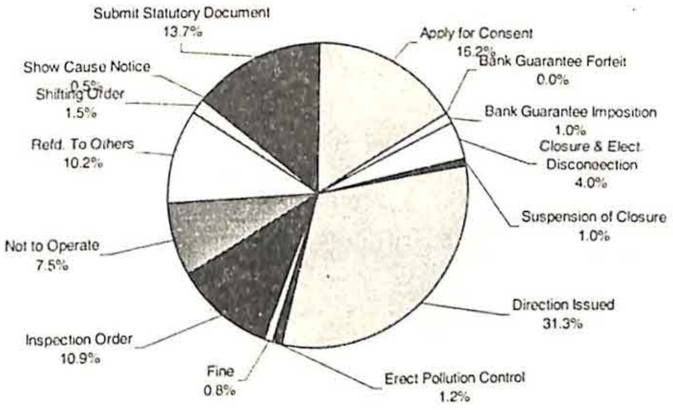
A synopsis of the public complaints against the different categories of industries is graphically represented below. The WBPCB also initiates penal actions against the defaulting units. For instance, the units that violate the legal standards and do not appear for the hearing given by the WBPCB are directed to close down. Bank guarantees are imposed on the units with a condition that should they again violate, the units would be closed down and the bank guarantees forfeited. The present status of such penal actions is also illustrated hereunder.

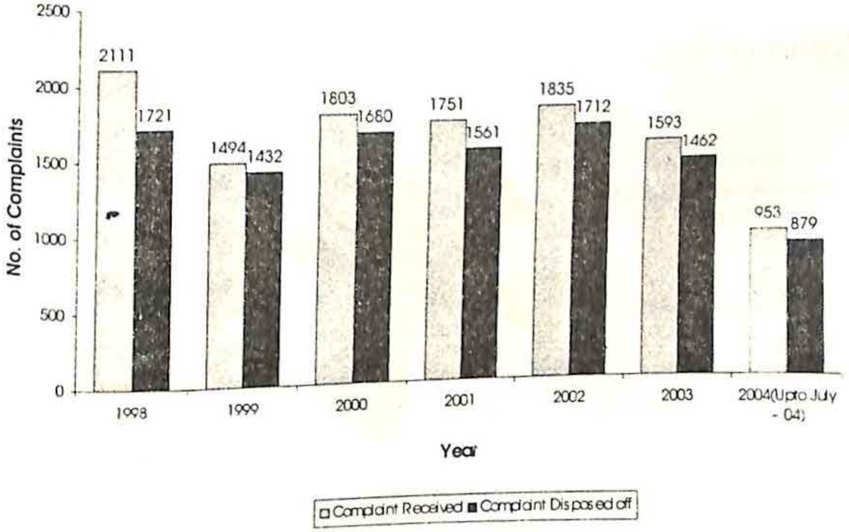


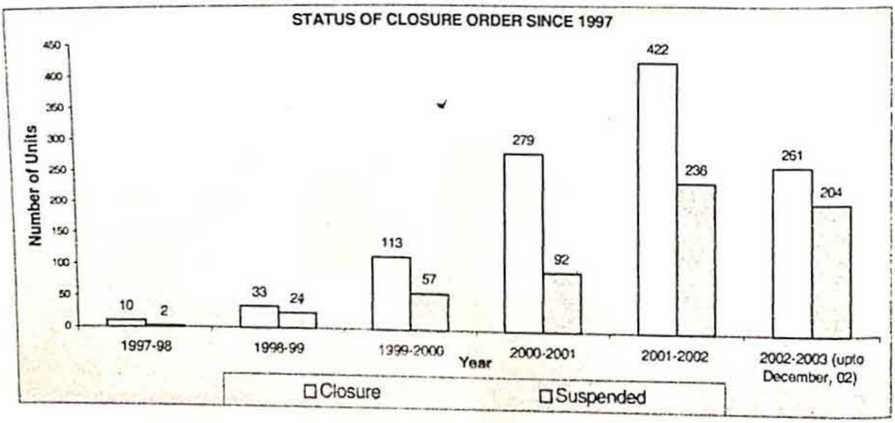
Average duration taken for Complaint processing



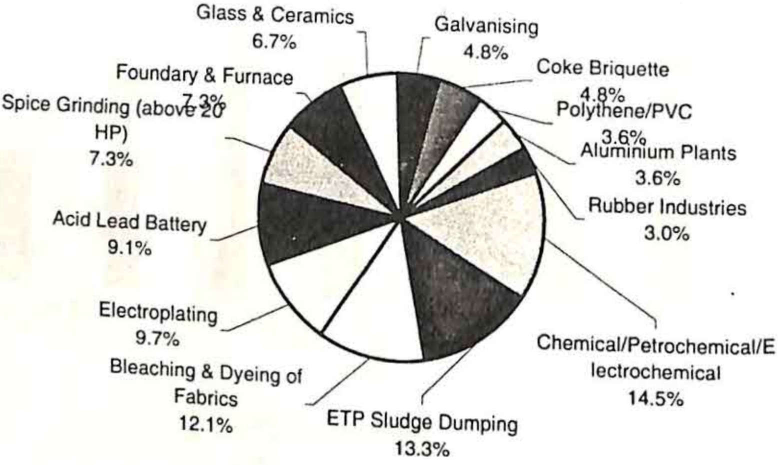
Status of Nature of Complaints


Summary of Orders Issued

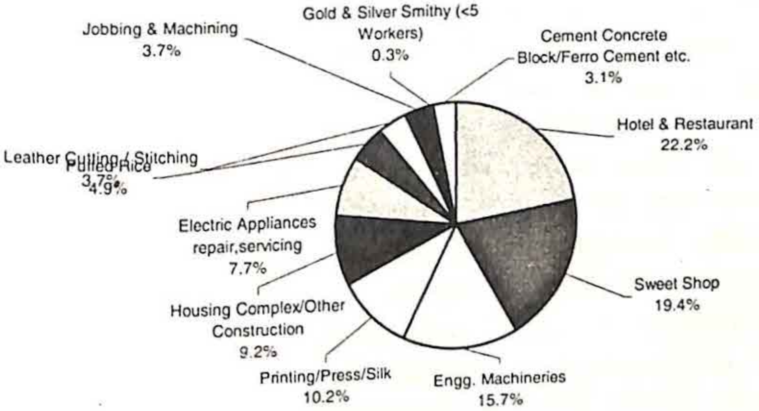

Status of Complaints Recieved and Disposed for Last Seven Years



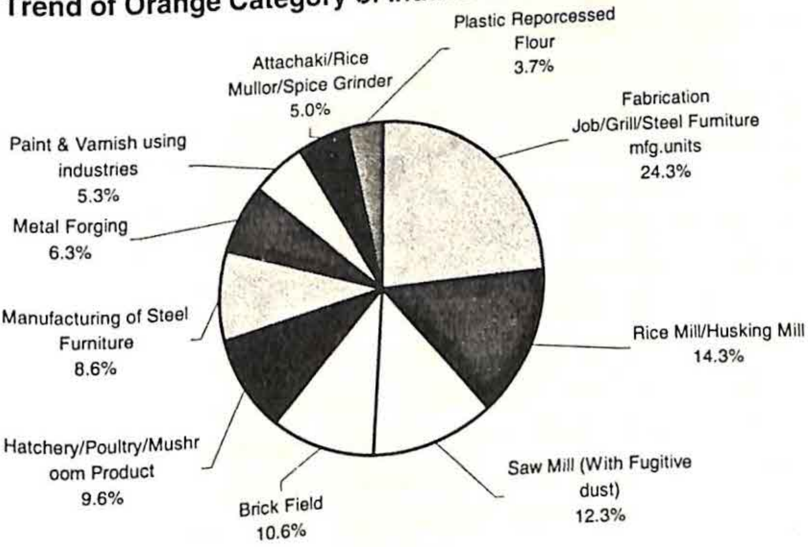
Trend of Red Category of Industries Complaint



Trend of Green Category of Industries complaint



Trend of Orange Category of Industries Complaint



Conclusion

In short, the primary objectives of this system are to establish a management system for handling citizen complaints, review long-term trends in complaint filings and their outcomes, and to identify trends or issues as they relate to complaints, utilising innovative solutions where possible. Whether we are a declining or an ascending generation, it all depends on the choices we made today. The fate of our future generation depends on how we manage our present life-support systems. The primary responsibility for cleaning up the environment, therefore, lies with the government, industries, citizen groups and individuals, in equal proportions. Much of what the WBPCB public grievance system does is meant to better prepare our citizens to accept their share of that responsibility.

Acknowledgement : Public Grievance Cell, WBPCB.

ABCs of NGOs

Rahul Ray

Non-Governmental Organisations (NGOs) or Voluntary Organisaions (VO$_S$) are today widely known to people in various names. NGOs are generally accepted as organizations which have not been established by Government or by agreement among the Governments. Voluntary Agencies (VAs), Action Groups (AGs), Grass Root Organisation (GROs), Non-Governmental Developmental Organisations (NGDOs), International Development Cooperation Institutions (IDCIs), Private Philanthropic Foundations (PPFs) and Non-Party Political Formations (NPPFs) are largely voluntary in nature and in their service objective. As per the United Nations Department of Public Information (1980) "Non-Governmental Organisations are any of those organisations which are not part of a government and which have not been established as a result of an agreement between governments. NGOs can be research institutions, professional associations, trade unions, chambers of commerce, youth organisations, religious institutions, senior citizens' associations, tourist bodies, private foundations, political parties, zionist organisations, funding or development-international and indegenous agencies, and any other organisation of a non-governmental nature'. According to Harold Jacobson, author of one of the established texts in international organization, NGOs, like Intergovernmental Organizations

(IGOs), have regular meetings of their members' representatives, specified decision-making procedures, and a permanent staff. The members are usually individuals and private associations, rather than states, and they may be of formally established networks of other organizations. The international partinence of NGOs in today's world has effectively been focused in 40th Annual General Assembly Meeting of UN in 1985 when it declared December 5 as International Voluntary Action Day. It is important to note here that all voluntary organisations are non-governmental. But all non-governmental organisations are not voluntary.

The existence of NGOs are noticed from the inception of United Nations. During globalization and in the period of amazing development of information technology the number of NGOs increased manyfolds all over the globe. During 1990s in the making of policies and programmes of UN the participation of NGOs was noteworthy and it now goes on increasing. For several years NGOs have been working with UN in its specific programmes to serve mankind and seek cooperation of UN. Recently the NGOs are demanding a greater role to play in decision-making and management. Apart from the NGOs, today new types of many 'non-state actors' have grown. They also are demanding their access in the programmes of UN along with the NGOs.

In human society today the relevance and importance of non-governmental and non-religious activities are gradually increasing. Organised efforts regarding development of economic and socio-cultural state of a parlicular community or area/region, human rights, urbanization, industrialization, pollution-free environment, abolition of terrorism and war etc are gaining much importance in society than earlier. During the late 1970s a type of organisations appeared to perform apolitical and non-religious activities in a special societal gamut. They introduced themselves in society as 'voluntary' and 'non-profit' organisations though the main workers used to earn something as remuneration for rendering social services.

At first the main objective of these 'voluntary' organisations was service to society. They completely avoided political issues, even the local ones. Usually they spent much time in spread of education, literacy campaign, economic self-sufficiency, health and family welfare etc.

Later, these organisations became widely recognised as Non-Government Organisations (NGOs). Scope of their activities also increased. Apart from service-oriented activities these NGOs weighed heavily on information gathering, promotion of public awareness, particular issue-based movement and empowerment and liberation of women, downtrodden and marginal communities. They did not directly utter to capture political power. But directly took part to preserve human rights, the constitutional rights of mankind, the rights of labourer, the rights of children, the rights of sex-workers, rights for pollution-free environment and the rights of marginal communities. Their characteristics, nature and field of work or struggle thus become indistingishable from other organisations of society.

Gradually these organisations become part and parcel of social activities. They become appreciated as 'civil society organisations'. Their domain of activity has surpassed the previous scope. They have identified the 'class-enemy'. These NGOs go on identifying the World Bank, International Moneytary Fund (IMF), World Trade Organisation (WTO), many Transnational (TNCs) corpporate bodies as chargeable for human sufferings and oppression. They have disapproved globalization and demonstrated its fatal effects on life and life suporting systems in summits of Johannesburg, Seattle and Cancun. They did not propose any societal structure, but supported the struggle for rights of downtrodden and marginal people. They even have stretched their helping hands to various political parties and communities in this regard.

NGOs are normally independent and are of different types. They may be local organisations as well as international organisations. Even they may be the organisations under the banner of any political party or religious groups. NGOs are quite different in their organisational structure and number of members from other organisations. They are discernably distinctive regarding their management, nature and field of work, credibility, efficiency and of course fiscal source. Some NGOs work together with existing government and do get regular grants. Naturally here arises the question of their independence.

NGOs do play effective role in making and accomplishment of versatile treaties. In many such occasions they acted as mediators. During civil wars their efforts for peace-making are impressive. They propagate ceaselessly to proscribe the use of landmines. With limited workers NGOs collect valuable information at national and international level within their statutes. They make people aware about these information in home and abroad. International NGOs spend a good amount of money every year in relief and development fund world- wide. In recent years the access of NGOs in UN is significantly nascent. They now have been placed in three distinct categories as consultants in Economic and Social Council in UN. Moreover, they are allowed to keep connection with the Department of Public Information in UN. NGOs do not have any access in the General Assembly and Security Council in UN. But they are constantly claiming it so that they may be treated as delegates as well as consultants in UN.

NGOs often preach for 'alternative' in this era of globalization. They themselves may be the competent alternative among the prevailing alternative forms of civil society. But of course there are some questions regarding their definition and nature. NGOs go on experimenting with different alternative models in the field of politics, economics, society and culture all over the globe.

The Rise of NGOs

Imperialism in its colonial era plundered the Afro-Asian-Latin American countries. These countries became colonies or semi-colonies of the imperialist forces. During Second World War the imperialists received mighty resistance from the oppressed people of these colonies or semi-colonies. The fascist forces were defeated by socialist forces led by Soviet Union. Imperialists were compelled to decolonize the afro-Asian-Latin American countries.

By nature imperialists cannot stay without plundering the resources and the toil of world people. Hence, it initiated new forms of plunder in disguise very cunningly after Second World War. The imperialists formed numerous institutions and agencies to bring the world under a global market system dominated by capitalists by various ways. They started using modern technologies to plunder world resources for the luxury of the elites and riches and to increase their profits. In this post-Second World War neo-colonial phase the people of Afro-Asian-Latin American countries were virtually pauperized. Their wealths of nation were exploited.

Again this system gave rise to increasing resistance by oppressed people in various forms. But the imperialists were cunning enough, formed many institutions and agencies to keep the people away from uniting in the path of class-struggle. They confused people to separate friends and foes in ideological, political, socio-economic, religious and cultural fields.

Thus, after the Second World War, hundreds of apparently voluntary organizations were grown in America with the help of Government. These organisations became ramified to spread out their activities in neo-colonial countries. These organizations got direct grants from governments. The nature and places of activities likewise were determined by the government. CARE (Co-operative for American Relief Everywhere), a part of "Marshal Plan", was introduced to help the European countries devastated by war. But during 1950's, after the restructuring of European countries, CARE totally cast an evil eye to the neo-colonial countries. America started supplying their surplus foods through CARE at first to Europe, then to other countries of the world as a part of anti-communist conspiracy. For this purpose 'World Vision' was formed. In a short period World vision spreaded its activities in twelve European countries and in eighty-five Afro-Asian-Latin American Countries. It is important to mention here that World vision gets huge grants from 'U.S. Agency for International Development'. It is operating more than 650 projects in India. Like World Vision, 'Save The Childrien', 'Christian Children's fund', 'Lutheran World relief', 'Chatholic Relief Services' etc. are other voluntary organizations working with this particular attitude.

During the Sixties the American voluntary organizations were scattered almost in all neo-colonial countries. To get prolonged obedience from these countries 'Peace Core' was formed in the name of philanthropic activities.

During mid-sixties, like America, the European countries started supporting the activities of the voluntary organizations directly and indirectly. They began to use voluntary organizations to debilitate communist activities. The then West Germany played the pivotal role. During late 1950's and beginning of 1960's various organizations were formed in West Germany, viz., **Action for World Solidarity, Bread for The World, World Peace Service, Protestant Association for Economic Cooperation, Catholic Association for Economic Cooperation,** and so on. **The German Ministry for Cooperation** was developed in 1961. The other European countries likewise formed theirs own voluntary organizations to slow down the pace of communism. e.g. , **The Ministry for Overseas Development** in England, **Swiss Development Corporation** in Switzerland, **Norwegian Agency for Development Cooperation** in Norway and so on. These organizations regularly communicated with each other. For this purpose **Peace Research Institutes** were formed in several European countries similar to 'Peace Core'. During late 1960's **International Council of Voluntary Agencies** was developed to harmonise with each other. These organisations were engaged in various projects like promotion of mass education and awareness against ecological degradation, women's Liberation, amelioration of downtrodden sections of society, child health and welfare, literacy campaign and so on. Many relief activities were also done. All these activities were intelligently performed to screen their original motif .

During 1970s recognition of the importance of NGOs initiated. NGOs were found to have closer ties to on-the ground realities in developing countries and perhaps more important to be able to deliver development aid considerably more cheaply than states of inter-governmental organizations. In fact, UN recognized the role of the NGOs as one of the specialized agencies of the UN system to percolate different ideas and aids specially to the Third World.

An NGO is basically dealing with the social work and also is actively involved propagating scienctific ideas in logistic and rational sence of humanity among the people. History and development of NGOs almost started from the days of Socretes, the most renowned philiosopher of the world. Socretes developed different clubs and one of the basic functions of these clubs was to discuss and develop a rationality among the people not to believe anything without analyzing in scientific manner. Such type of scientific or enlightened clubs also observed at the time of French Revolution in France and in different parts of Europe. Russo, like many philosophers, also developed such enlightened clubs to propagate their philosophy among the common people and in the long run such clubs almost turned into a point of changing people's attitude towards society. During the British Raj , emergence of Young Bengal Club is one of such type of NGOs where most eminent philosophers and enlightened people came together with their ideas and almost gave birth to a new renaissance to Indian sub-continent.

Generally, NGOs have social commitments, but they don't take part in politics directly. Their main intention is to make some social work on the basis of a particular philosophy. Presently in India ,large number of NGOs are working on different arenas. Some of the NGOs are very active on human rights, child-labour issue and womens' right. Since 1970 and onwards, there is a trend of developing of some NGOs on environmental matters. After Stockholm Conference in 1972, slowly but steadily environmental awakening is being developed in India and in the wake of such awakening role of the NGOs is extremely beneficial and also important. A large number of public interest litigations was filed before the different judicial forums by the NGOs regarding the environmental issues. In India, different science clubs were developed, which are also functioning as NGOs and in some cases they are also involved actively on environmental issues. Like science · clubs, different mountaineering associations, tree- lovers' associations, animal-lovers' associations are also functioning for the cause of protection of environment.

Types of NGOs

NGOs are mainly of two types. The **first one** works for income generation. This groups always thinks about that very model of development by which generation of income is possible. For this purpose they follow the path of empowerment through entitlement. In this group three distinct categories of NGOs are noticed. The NGOs who work in unorganized labour front of landless farmers, tortured women, slum dwellers and downtrodden people are called 'Gross-root' NGOs. They confine their activities generally at grass-root level. They are engaged in activities like rehabilitation, aid, grant and other philanthropic works. The other category of NGOs work for their 'target groups'. The target groups usually get bank loans, government grants, education loan, grants in agriculture and healthcare through these NGOs. Here the beneficiaries are termed as 'target groups'. The last category of NGOs are participants in new professions of development. They are known as 'New Generations'. They try to upgrade the quality of lifestyle of people. In order to achieve this they stress on research in human development and management. The NGOs of this third category are large in numbers and they used to get a good amount of national as well as international fiscal aid.

The NGOs of the **second** type are those who organize people for an alternative movement. They are naturally small in numbers. Their financial capacities are limited, but have more socio-political influence in country. They unite the downtrodden people for class-struggle. In the struggle of socialist and progressive forces these NGOs play a helpful role. In India the names of Sundarlal Bahuguna, Baba Amte and Medha Patekar need be mentioned for their effective effort to organize alternative mass-movement to save environment as well as to promote mass awareness.

Financial Sources of NGOs

From the late 1960s various UN-approved private organizations started giving grants for development to many national governments as well as official social organizations (NGOs) working in different nations. These private organizations used to invest money in business to make profits. The prime feature of the non-governmental organizations was 'non-profit social activities'. The intension was very clear. UN had the responsibility to reduce socio-economic inequalities in different countries. Hence, the system of grant was introduced for development in less developed countries through the NGOs.

Later, many religious organizations have come to help these NGOs financially in development work. Today different multinational companies (MNCs) and big business organizations have funded to these NGOs. In rich countries of the world several organizations collect money from the people who support humanism and send it to various NGOs in less developed countries of the third world. This kind of collection also takes place in less developed countries. The spread of the system of grant has given birth to many NGOs from the late 1970s. Before sanctioning grants an appraisal of the particulars of NGOs is generally made.

NGOs in India With Special Reference to West Bengal

After 1970 the number of NGOs in India increased suddenly. Most of them were nourished by foreign funds. Today India has more than forty-five thousands of non-governmental voluntary organisations. In our State their number already exceeds four thousand.

Before independence some followers of Mahatma Gandhi founded some schools (ashrama) and they started experimenting with different forms of alternative. But after 1950 during the period of widespread industrialisation these *asramas* lost importance and gradually failed to exist. But again after the naxalite movement during 1970s pro-Gandhi Joyprakash Narayan initiated an alternative movement for a short period. This movement inspired many idealistic youths. Hence, it is noticed that the persons who formed NGOs after mid-1970s in India were of different types, viz., the followers of Gandhi, former naxalites, followers of Joyprakash Narayan and some Christian youth and missioneries influenced by South American Liberation Theology. Some of the noted NGO movements have been discussed briefly here-in-under.

During 1970s India witnessed two big environmental movements, viz., the 'Silent Valley' movement in Kerala and the 'Chipko' movement in Garhwal region. 'Kerala Sahitya Sastriya Parishad' (KSSP) and its leader Parameshwaran led the Silent Valley movement. The leaders of Chipko movement were Sundarlal Bahuguna, Vimala Bahuguna, Chandi Prasad Vat and others. Both the movements were organised to save trees and forests.

During 1980s, the most noteworthy environmental movement of India was 'Narmada Banchao' movement led by Medha Patekar. The powerful pen of Arundhati Roy was a great fillip to the movement.

In 1982, Late Anil Agarwal, the then editor of 'Down To Earth' magazine, published a report titled 'Citizen's Report on The

State of India's Environment'. The report shook the country. Agarwal formed 'Centre for Science and Environment' (CSE) in New Delhi to save environment. Almost at the same time Vandana Shiva started to write feminist articles. The themes of her articles today are widely known as 'Feminist Ecology'/ 'Green Feminism' / 'Eco-feminism'. Vandana founded an institution named 'Nabadarsha' in Dehradun. Nabadarsha plays an important part in ecocentric agro-movement. In the sphere of environment and ecology-related issues in India the names of Prof. Madhab Gadgil and social scientist Ram Chandra Guha are worth-mentioning.

In 1974 ASTRA (Application of Science and Technology to Rural Areas) was formed in Bangalore under the leadership of Prof. Amulya Reddy. Prof. Reddy was very enthusiastic about appropriate technology in search for an alternative.

In 1970s, many alternative experiments in the field of education and healthcare took place. A good many scientists from different parts of India engaged themselves in this work under the leadership of Anil Sadgopal in 'Hosangabad Science Teaching Programme' (HSTP). Later HSTP was known as 'Eklabya'. Ekalabya did a commendable work in the field of school education under the leadership of Vinod Raina. In this decade Mr. and Mrs. Arole had done outstanding work in the field of rural health in Jamsed area of Maharastra. Today numerous NGOs are functioning in the field of education and health. But many of them have grown stale on the job. It is due to the fact that the government does not perform its duty in these fields. Prof. Amartya Sen is repeatedly making it a point to be more attentive in the sphere of health and education. He has suggested alternative form for this purpose.

In Chattisgarh Sankar Guha Neogi had formed 'Chattisgarh Mukti Morcha' as an would - be form of alternative trade union for the welfare of labourers. But he had to sacrifice his life for this because it was impossible for any political party to endure his alternative forms of actions. In Maharastra 'Swetkari Sangathan' led by Sarod Joshi and in Karnataka 'Rayat Sangh' led by Nanjudswami showed fighting spirit to form alternative organisation of farmers.

In Ahmedabad Ila Bhat organised some women vegetable sellers. Later she founded a bank named 'SEWA' (Self Employment Women of Ahmedabad) from where they got banking facilities and loan. Today in India hundreds of NGOs are active to organise small groups of poor women and to make them engaged in various developmental activities. From 1960s onwards big cooperatives of milk producers were started to form in the villages of Gujrat under the leadership of D.Kurian. In the following three decades in many states of India several milk and edible oil cooperatives were formed with the help of NDDB.

During 1970s some NGOs in south and west India had done striking jobs in eco-friendly agriculture, soil and water management, alternative irrigation, afforestation in fallow and badlands and in watershed management. Anna Hazare ushered the NGOs to these fields. Among these NGOs the names of Myranda, BAIF, Aurodil, Greenwork are worth-mentioning.

During the end of 1970s an effort was initiated to unite different NGOs working in various fields to form a platform or network. Some of such worth-mentioning platforms are 'Voluntary Health Association of India' (VHAI), 'Federation of Voluntary Organisations for Rural Development' (FEVORD), 'Bharatiya Jnan-Vijnan Samity' (BGVS), 'National Fishermen's Forum' (NFF), 'Voluntary Action Network of India' (VANI) and 'National Aliance for People's Movement' (NAPM). Here it is important to mention that various magazines, literatures and books cooperated immensely in alternative movement of NGOs.

In **West Bengal** in the sphere of NGOs' activities the foremost name to mention is of late Pannalal Dasgupta. He was the founder of 'Tagore Society for Rural Development' (TSRD). Once this organisation was very much active in three states, viz., West Bengal, Orissa and the then Bihar. During 1970s in Rangabelia of Sundarban Tushar Kanjilal and Bina Kanjilal formed 'Women's Organisation' under the umbrella of TSRD. They took village-wise many programmes at grass-root level. During this period a village-development branch of Ramkrishna Mission named ' Lok Siksha Parishad' became very active under the leadership of Shibsasnkar Chakravorty. The decade of 1970 witnessed many more NGOs in our state. The names and particulars of some NGOs are given briefly here-in-under in table – 1.

Table -1

Name of NGO	**District**	**Formed/Led by**	**Field of interest**
1. Socio-Economic Development Progroamme (SEDP)	Worked in many districts	Tapas Das	Socio-economy
2. Institute of Monitoring Self Employment (IMSE)	Birbhum	Biplab Halim	Self employment
3. Rural Development Association (RDA)	Medinipur	Dipankar Dasgupta	Rural Development
4. School of Fundamental Research (SFR)	Purulia	Biplab Basu	Literary campaign and spread of education

5. Loksiksha Parishad, Branch of "Kalyani'	Purulia	Ramkrishna Mission	Literary campaign and spread of education
6. Gandhi Bichar Parishad	Bankura	Sisir Sanyal	Upgradation of downtrodden people
7. Harijan Sevak Sangha	Howrah	-	Upgradation of Dalits.
8. Tajmahal gram Vikas Kandra	Howrah	Moinuddin	Development of villages.
9. Mandra Unnayan Samsad	Hooghly	-	Developmental works
10. Ushagram Trust	Nadia	Gopal Chakravorty	Self employment and development
11. Shreema Mahila Samity	Nadia	Beena Saraswati	Self employment and development of women
12. Centre for Community Devlopment (CCD)	24- Parganas (N)	Swapan Mukherjee	Community development
13. Mass Education	24-Parganas (N)	Sukumar Singh	Education for all
14. Child In Need Institute (CINI)	24-Parganas (S)	Samir Chowdhury	Training of Nurses, health care for children, formation and training of village health workers

15. West Bengal Voluntary Health Association (WBVHA)	Worked in many districts	D.G.Poddar of (VHAI)	Healthcare
16. Bengal Rural Welfare Society (BRWS)	Worked in many districts	Santanu Bhattacharya	Health Care
17. Association of Voluntary Blood Donors (AVBD)	Worked in many districts	Debabrata Roy	Voluntary blood donation
18. Bengal Social Service League (BSSL), Later known as State Resource Centre.	Worked in many districts	Satyen Mitra	Spread of education at all levels of Society,Literacy campaign
19. Bangiyo Nirakkharota Durikran Samity	Worked in many districts		Spread of education and leteracy campaign
20. All India Council for Mass Education and Development (AICMED)	Worked in many districts		Education for all

(Source : S. Sinha in Chetana)

Here it is very interesting to note that the number of NGOs in North Bengal is noticeably meagre. During 1970s some big NGOs merged together to form **'Rural Development Consortium' (RDC)** to cooperate with small NGOs. In village-development activities at that time two pioneer NGOs were **'Lutheran World Service' (LWS)** and **CASA**. Both were missionery organisations.

During the eighties the following noted NGOs had grown (table-2).

Table - 2

Name of NGO	District	Formed/Led by	Field of interest
1. Unnayan	Worked in many districts.	Joy Sen	Information gathering, rights of housing.
2. Development Research Communication and Service Centre (DRCSC)	Worked in many districts.	Arhendusekhar Chattopadhyay	Information gathering, to help documenting other organisations
3. Swayamvar	Worked in many areas.	Vikram Sen & Neela Sen	To help earn livelihood through handicrafts.
4. Jana Samhati Kendra (JSK)	Worked in many districts.	Anuradha Talwar & Swapan Ganguly	People's movement for alternative, rights of landless labourers.
5. People's Institute for Rural Action (PIRA)	Howrah		Upgradation of poor and oppressed village women, alternative form of agriculture
6. Women's Coordination Council (WCC)	Kolkata		Upgradation of poor women in metropolis.
7. All Bengal Women's Union (ABWU)	Kolkata		Upgradation of poor women in metropolis.
8. Nagarik Mancha	Worked in many districts		Alternative labour organisation for heathcare, and other problems of labourers, publication of pamplets,leaflets, books to enhance public awareness
9. Samlap		Indrani Sinha	Spread of education, connselling and legal

			assistance to girls and poor women, research and information gathering.

(Source : S. Sinha in Chetana)

Due to growth of NGOs' functions, Government of West Bengal is also now seriously thinking about the functioning of the NGOs on different matters. W.B. Government is also taking help of the NGOs for penetration of some new thoughts among the people. West Bengal Pollution Control Board started their function through NGOs for environmental awakening programme since 1990 in different districts.

The West Bengal Pollution Control Board (WBPCB) has involved a total number of 148 NGOs to deal with environmental issues, to make people aware about environmental laws and their application, to conserve forests, flora-fauna, water and wetlands, to control air, water, land and noise pollution, to prevent the use of plastic carry-bags in ecologically sensitive areas, to enhance the personal hygienic sense and the quality of public health, and above all, to protect the environment of the state as a whole. The district-wise names and addresses of NGOs are given in table – 3.

Table - 3

Region / District	Total number of NGOs	Name	Address

Bankura	**3**	**1. Charabedia Rural Economic & Area Development Society (CREADS)**	Vill.- Charabedia P.O.-Layeskpara, Dist – Bankura, Pin – 722151
		2. Dhansimla Socio- Economic Research & Development Organisation.	P.O. – Dhansimlao Dist. – Bankura PIN – 722110
		3. My Dear Trees & Wilds	Dhulpara, Mukutganj, (Behind Manisha), P.O.- Bhisnupur Dist.- Bankura PIN - 722122
Birbhum	**3**	**1. Dharaninagar Rural Development Society**	Vill.- Shibpur, P.O.- Mollarpur Dist.- Birbhum
		2. Dubrajpur Kacharipara Rural Energy Development Association	Vill. & P.O.- Khayrasol Dist.- Birbhum
		3.Ulphari Adibsi Human Resources & Environment Development Society	P.O.- Damra Dist. – Birbhum PIN – 731216
Burdwan	**4**	**1. Akabpur Sammelani**	P.O.- Nadanghat Dist.- Burdwan PIN - 713515
		2. Kulai New Agragami Yuba Sangha	Vill.- Kulai, P.O.- Kulai Dist. – Burdwan PIN – 713143

		3.The Durgapur Citizens' Development Centre (DCDC)	BDN – Arrah, Durgapur Dist. – Burdwan PIN - 713212
		4. Uchitpur Nabin Sangha	Vill. – Uchitpur P.O.- Sanktia Dist.- Burdwan PIN - 713408
Hooghly	**7**	**1. Hiranyabati Gramin Silpa Niketan**	Vill. – Hiranyabati P.O.- Dhaniakhali Dist.- Hooghly
		2. Hooghly Mass Education Society	27/1, J.N. Gupta Lane Baidyabati, Hooghly PIN - 712222
		3. Kamarkundu Krishna Social Welfare Society	Vill & P.O.- Kamarkundu, P.S.- Singur, Dist.- Hooghly PIN - 712407
		4. Kantali Relief And Welfare Society	Vill & P.O.-Kantali P.S.& Block- Goghat-I Dist.- Hooghly PIN - 712614
		5. Manab Seva Mission	Vill - Choutara P.O.- Kaikala P.S.- Haripal Dist.- Hooghly PIN – 712405
		6. Radhanagar Palli Samity	Vill - Radhanagar P.O.- Nangulpara Dist.- Hooghly PIN - 712406
		7. Tarakeshwar Science Club	C/o Santanu Mitra B.P. Gate, Tarakeshwar Dist. – Hooghly

Howrah	**16**	**1. Agradut Pally Unnayan**	Vill & P.O.- Gaza Dist.- Howrah PIN - 711226
		2. Ananda Angan	Vill.- Asanda P.O.- Dehibhursitta Dist.- Howrah PIN - 712408
		3. Bantra Public Library	42/3, Lakhsminarayan Chakravorti Lane Howrah - 711101
		4. Chiranabin	Vill.- Parbakshi P.O.- Bakshi Dist.- Howrah PIN - 711303
		5. Domjur Block Unnayan Samity	Salap Dist.- Howrah PIN - 711409
		6. Gajipur Sri Aurobindo Seba Samity	Vill & P.O.- Gajipur P.S.- Amta Dist.- Howrah PIN - 711413
		7. Khardaha Public Cultural & Welfare Association	Vill.- Khardaha P.O.- Tulsiberia Dist.- Howrah PIN – 711401
		8. Mahishamuri Pallimangal Samity	P.O.- Nowpara Block- Amta -II Dist.- Howrah PIN - 711401
		9.Matri-O-Sishu Bikash Kendra	Vill.- Garmirjapur P.O.- Mashila Dist.- Howrah PIN - 711302

		10. P.M. Basti Bariwala Association	23/1, P.M. Basti 3rd Lane P.O.& P.S.- Shibpur Howrah - 711102
		11. People's Union For Development & Reconstruction	30/3-A Narasingha Dutt Road Howrah - 711101
		12. Rajapur Seva Niketan	Vill.- Rajapur P.O.- Karatberia P.S.- Uluberia Dist.- Howrah PIN - 711316
		13. Samarpan	South Baksara Road Bottola P.O.- Banksara Dist.- Howrah PIN - 711301
		14. West Bengal Gandhi Peace Foundation	Sarvodaya Park P.O.- Duilya Dist.- Howrah PIN - 711302
		15. West Bengal Tae Kwon-Do Academy	100/3, Sashi Bhusan Mukherjee Lane Howrah- 711106
		16. Society For Advancement of Village Environment (SAVE)	23/2, Kshetra Mitra Lane, Salkia Howrah PIN - 711106
Jalpaiguri	**2**	**1. Duars Alternative Medical Research Institute**	Udayan Bitan, Surja Nagar Alipurduar Court Dist- Jalpaiguri PIN – 736122

		2. Alipurduar Nature Club	Newton, P.O.- Alipurduar Court Dist. – Jalpaiguri PIN - 736122
Kolkata	**39**	**1. Adwaita Maliabarman Educational And Cultural Society**	148, Keshab Ch. Sen Street Kolkata - 700009
		2. Apanjan	16A, Tollygunj Railway Colony (C.C.Place East) Kolkata - 700033
		3. Assit India	412/C, N.S.C. Bose Road, Kolkata - 700047
		4. Behala Pipilika	133/A/4, B.C.Road Behala Kolkata- 700034
		5. Beleghata Pradipan Association	29A/12, Chaul Potti Road. Kolkata - 700010
		6. Bengal Social Service League	1/6 Raja Dinendra Street, Kolkata - 700009
		7. Birati Mahajati Vidyamandir (H.S.)	M.B. Road, Mahajati Nagar (I) Kolkata - 700051
		8. Centre For Study of Man And Environment (CSME)	Paribesh Kendra CK-11, Sector-2 Salt Lake City Kolkata - 700091
		9. Charabedia Rural Economic & Development	131, Dr.A.L.Paul Road Behala

		(CREADS)	Kolkata - 700034
		10. Council For Action of Rural Economy (CARE)	378, Diamond Harbour Road Kolkata - 34
		11. Diganta (Calcutta)	96A, Bangur Avenue Kolkata - 700034
		12. Durganagar Vivekananda Memorial Society (DVMS)	45, Sahid Badal Sarani Durganagar North Kolkata - 700065
		13. Gana Unnayan Parshad	10, Gomesh Lane Kolkata - 700014
		14. Garden Reach Bangla Basti Academic Development Society	G-38, Bangla Basti Garden Reach Kolkata - 700024
		15. Garden Reach Kasab Para Social Welfare Association	1-24/A, Kesab Para Garden Reach, Kolkata - 700024
		16. Global Environment Research Foundation	4, Sasankalitala Rd. P.O.- Barisha (Behala) P.S.-Thakurpukur Kolkata – 700008
		17. Haltu Dr. B.R. Ambedkar Smriti Raksha Samity	89, Purbachal Rd (N) Kolkata - 700078
		18. Indian Institute of Training And Development	Srijoni P.O.- Joka Kolkata – 700014

		19. Kolkata Creative Art Performers	IC – 839, Sec.- III Salt Lake Kolkata - 700091
		20. Manbhum Ananda Ashram Nityananda Trust (MANT)	68/7, Purna Das Road Kolkata – 700029
		21. Manicktala Multipurpose Integrated Rural Urban Association	10/C/57, Wards Institution Street Maniktala Kolkata - 700006
		22. Mili Mission of Bengal	7/1, Jannagar Road P.O. Box 16035 Kolkata - 700017
		23. Nimta Eco-Development Society	Vidyasagar Palli Kabi Satyen Dutta Rd. P.O.-Nimta Kolkata - 700049
		24. North East Calcutta Social Welfare Organisation	64, Hem Chandra Naskar Road Kolkata - 700010
		25. Oncolink	11C, Vidyasagar Street Kolkata - 700009
		26. Pannajheel Hi-Tech Agriculture And Rural Development Service Society	Pannajheel Block – 2 P.O.- Noapara Barasat Kolkata - 700129
		27. Paschim Banga Manab Kalyan Bikash Kendra	AB 31, Salt Lake City Kolkata – 700064

		28. Paschim Banga Juba Kalyan Mancha	1/1/28, Kailash Ghosh Road Kolkata – 700008
		29. Prerana (Social Service Organisation)	47/10, Ganguli Bagan East Road Ashoke Trust, Garia Kolkata – 700084
		30. Rajabazar Education & Awareness Development Society (READS)	28/H/50, Gas Street (Raja Bazar) Kolkata – 700009
		31. S.M. Education Society	D-202 Kaikhali Enclave, Mandaganthi, P.O.- Airport Kolkata – 700052
		32. Sahara Health & Education Society	Sahara Sarani, Defence Park Kolkata – 700141
		33. South Asian Foudation For Human Initiatives (SAFHI)	22, A.J.C. Bose Road Space 3A, III Floor Kolkata – 700017
		34.Sutanuty Institute For Woen & Child Development	408, Gokul Boral Street, Kolkata - 700012
		35. Team For Reconstruction of Environment Education And Socio-Economy (TREES)	41/68, Jivan Krishna Mitra Road Kolkata – 700037
		36. The Institute Of Value Orientation	149/1E, Rashbehari

		And Environmental Education (Vevekananda Nidhi)	Avenue Kolkata - 700029
		37. The Young Explorers' Institute For Social Service	C-2/8 Korunamoyee Estate, Salt Lake Kolkata - 700091
		38. Village Welfare Society	F-3, Geetanjali Park Ariandaha, Kolkata – 700057
		39. Barasat Unnayan Prostuti	Basundhara, Noapara, Barasat, Kolkata – 700125
Malda	**2**	**1. Chanchal Jana Kalyan Samity**	Chanchal College Rd. P.O.- Chanchal Dist,-Malda PIN- 732123
		2. Malda Sahayogita Samity	S.C. Road, P.O.-Old Malda, Dt.- Malda PIN – 732128
Murshi dabad	**3**	**1. Beldanga Association For People's Upliftment (BAPU)**	Vill.- Uttarpara, P.O.- Radharghat, P.S. – Berhampur Dist.- Murshidabad PIN - 742189
		2. Malopara Simanta Welfare Organisation	Vill.- Malopara P.O.- Rajapur Dist.- Murshidabad PIN - 742306
		3. Palsa Pally Unnayan Samity	P.O. – Gorora P.S.- Nabagram Dist.- Murshidabad PIN - 742184
Nadia	**6**	**1. Bhabanipur Kumudini Smriti**	P.O. – Bagula Dist. – Nadia

		Sevashram O Siksha Niketan	PIN - 741502
		2. Chapra Social & Economic Welfare Association	Chapra, P.O. – Bangaljhi Dist. – Nadia PIN - 741123
		3. Debagram Gram Unnayan Kendra	Vill & P.O.- Debagram Dist. – Nadia PIN - 741137
		4. Kalyani People's Awareness Centre	A-9/1, Kalyani Dist. – Nadia PIN - 741235
		5. Karimpur Social Welfare Society	Tarak Das Road P.O.- Karimpur Dist. – Nadia PIN - 741152
		6. Parabar Gosthi	Netaji Park, Chakdaha Nadia
24 Pgs(N)	**15**	**1. Barasat Block – 1 Janakalyan Samity**	Vill. & P.O.- Bohera P.S.- Barasat Dist.- 24 Pgs (N) PIN - 743294
		2. Bijnan Darbar	585, Ajoy Banerjee Road (Near Binodnagar P. O.), P.O.- Kanchrapara Dist.- 24 Pgs (N) PIN - 743145
		3. Comprehensive Area Development Service	5/2, R.B.C. Road, P.O.- Naihati Dist.- 24 Pgs (N) PIN - 743165
		4. Gobardanga Renaissance	P.O.- Khantura Dist.- 24 Pgs (N)

		Institute	PIN - 743273
		5. Gram Seva Sangha	Sachindra Kargupta Path, P.O.- Hatthuba, Habra, Dist.- 24 Pgs (N) PIN - 743269
		6. Hizlia Janakalyan Samity	Vill. – Hizlia, P.O.- Asokenagar, Dist.- 24 Pgs (N) PIN – 743222
		7. Kirtipur Agradut Samity	Vill.-Saiberia P.O. – Kirtipur Dist.- 24 Pgs (N)
		8. Madhyamgram Green March	384 Basu Nagar, Madhyamgram Dist.- 24 Pgs (N)
		9. Panitar Pally Unnayan Samity	Vill & P.O.- Panitar Dist.- 24 Pgs (N) PIN - 743292
		10. Pather Dabi Rural Development Society	Vill.-Teghoria P.O.- Gandharbapur Via Katiahat Dist.- 24 Pgs (N) PIN - 743427
		11. Shayamnagar Voluntary Eye, Dead – Body Donors' And Philanthropic Society	172/3, Banerjee Para Road, P.O. – Shyamnagar Dist.- 24 Pgs (N)
		12. Jugal Kishore Palli Unnayan Sangha	P.O.- Ghonza Dist.- 24 Pgs (N) PIN - 743249
		13. Machhalandpur Bijnan Chetana Mancha	P.O.- Maslandpur Dist.- 24 Pgs (N)

		14. Nir Ideal Home For Mentally Retarded & Associated Disability	Vill.- Pilkhana P.O. & P.S.- Haroa Dist.- 24 Pgs (N) PIN - 743425
		15. Agragami Sangha	Vill. & P.O.- Malekanghumti Dist.- 24 Pgs (N) PIN - 743430
Paschim Medinipur	**4**	**1. Avinandan Club**	Vill.- Kushda P.O.- Kunarpur P.S.- Narayangarh Dist.- Paschin Medinipur PIN - 721437
		2. Birkota Rural Development Organisation	Vill. & P.O.- Dasagram, Dist.- Paschin Medinipur PIN - 721437
		3. Jhanjia Sanchayan Club	Vill. & P.O.- Jhanjia, Dist.- Paschin Medinipur
		4. Lok Seva Parishad	Post – Khirpai Dist.- Paschin Medinipur
Purba Medinipur	**18**	**1. Alinan Ramakrishna Vivekananda Yuva Sangha**	Vill & P.O.- Alinan Dist.-Purba Medinipur
		2. Alukaranbarh Seva Sangha	P.O.-Alukaranbarh P.S.- Bhupatinagar Block-Bhagwanpur-II Dist.-Purba Medinipur
		3. Bivisonpur Three Star Club	Vill & P.O.-Bivisonpur Dist.-Purba Medinipur

		4. Deriachak Vidyasagar Social Welfare Organisation	Vill & P.O.- Deriachak P.S.- KTPP (Kolkaghat) Dist.-Purba Medinipur PIN - 721151
		5. Deulichak Palli Unnayan Samity (DPUS)	Vill.- Deulichak P.O.- Dabuapukur Dist.-Purba Medinipur PIN - 721151
		6. Dharampur Samaj Kalyan Samity	Vill.- Dharmapur, P.O.- Deulpota Dist.-Purba Medinipur PIN - 721670
		7. Gangadharchak & Dewanchak Vivekananda Club	Vill.- Dewanchak P.O.- Gangadharckak Block – Contai III Dist.-Purba Medinipur PIN – 721444
		8. Gholemaguri Vevekananda Samaj Kalyan Samity	Vill.- Gholemaguri P.O.- Mahadole Dist.- Purba Medinipur PIN – 721634
		9. Gopinathpur Millenium Club	Vill. & Post-Gopinathpur Dist.-Purba Medinipur PIN – 721633
		10. Haldia Vigyan Parishad	Vigyan Bhaban P.O.-Haldia Township Dist.-Purba Medinipur PIN – 721607
		11. Kalindi Tarun Sangha	Vill. & Post- Kalindi Block- Ramnagar II Dist.-Purba Medinipur PIN – 721461
		12. Kaliswar Yuva Chatra Sangrami	Vill.-Kaliswar P.O.-Dehati

		Sangha	Dist.-Purba Medinipur PIN – 721139
		13. Kolaghat Science Hobby Centre	P.O.- Kolaghat Dist.-Purba Medinipur PIN – 721134
		14. Mahammadpur Development Mahila Samity	Vill - Mohammadpur P.O.- Mohammadpur Dist.-Purba Medinipur PIN – 721601
		15. Midnapore District Council for Social Welfare	P.O.- Egra Dist.-Purba Medinipur PIN – 721429
		16. Purasottampur Sarat Smriti Sangha	Vill - Purusottampur P.O.- Raghunathbani Dist.-Purba Medinipur
		17. Sarboday Sangha	Vill & P.O.- Ajoya Dist.-Purba Medinipur
		18. Gholemaguri Vivekananda Samaj Kalyan Samity	Vill - Gholemaguri P.O.- Mahadole Dist.-Purba Medinipur PIN – 721634
Purulia	**1**	**1. Institute of Traning and Development (ITD)**	Dhobapara P.O.- Raghunathpur Dist.- Purulia PIN – 723133
24 Pgs (S)	**12**	**1. Amra Sabai**	Kailashpur Dist.- South 24 Pgs PIN – 743349
		2. Bahnru Maheshpur Vivekananda Janakalyan Sangha	Vill & P.O.- Bhanru Ramrishnapur Dist.- South 24 Pgs PIN – 743610
		3. Dakshin Durgapur Ksudiram Smriti Sangha	Vill.- Dakshin Durgapur

			P.O.- Sree Durgapur Block –Pathar Pratima Dist.- South 24 Pgs PIN – 743349
		4. Dakshin Laxminarayanpur Yuba Sangha & Pathagar	P.O.- Pathar Pratima Dist.- 24 Pgs (S) PIN - 743371
		5. Dwip Shyamashree Sangha	Vill – Dwip (Chawghari) P.O.-Ghatakpur Dist.- 24 Pgs (S)
		6. Gourdha Pally Sree Voluntary Organisation	Vill. & P.O.- Gaurdha P.S.- Canning Dist.- 24 Pgs (S)
		7. Harishpur Pally Unnayan Samity	Vill. – Harishpur P.O.-Batheria Dist.- 24 Pgs (S) PIN - 743503
		8. Jogendranagar Mahila Samity	Sanjoy Pally Canning Town Dist. – 24 Pgs.(S) PIN – 743329
		9. Kundey Social Welfate Centre	Vill. Kundey P.O.-B. Bagaria P.S.- Kulpi Dist.- 24 Pgs (S) PIN – 743332
		10. Lokmata Rani Rashmoni Mission	P.O.-Nimpith Ashram Dist.- 24 Pgs (S) PIN – 743338
		11. Mahila Sevayatan	Vill.- Mojlispur P.O.-Pairachali Via - Bishnupur

			Dist.- 24 Pgs (S) PIN – 743503
		12. Mass Waker Organisation	Vill.- Chaughaui P.O.-Jeliabati P.S. – Mandir Bazar Dist.- 24 Pgs (S) PIN – 743336
		13. Narayan Smriti Sangha	Vill & P.O.- Madhausudan Chalk P.S.- Raidighi Dist. – 24 Pgs. (S) PIN – 743349
		14. Neo Indian Association for Rural Development	Chatterjee Para, South Garia Dist.- 24 Pgs (S) PIN - 743613
		15. Pragoti Sangha Choto Baidyahat	Vill.- Choto Baidyahat P.O.-Baidyahat Dist.- 24 Pgs (S) PIN – 743336
		16. Sramik Visya Mandir	Vill & P.O. – Sirakole Dist.- 24 Pgs (S) PIN – 743513
		17. Suchinta (Mahila Samity)	Vill – Dakshin Chowghari P.O.-Jeliabati Dist.- 24 Pgs (S) PIN – 743336
		18. Sundarban Agro-Eco and Socio- Educational Society	1 No. Dighirpar (Near Khadi Society) P.O.-Canning Town Dist.- 24 Pgs (S)
		19. Tofa Pally Milani Sangha	Sarishahat (Near Durga Mandap)

			P.O.-Sarisha Dist.- 24 Pgs (S) PIN – 743368
		20. Thumkati Gramin Unnayan Sanstha	Vill. – Thumkati P.O.-Khas Kumra Khali Via Taldi Dist.- 24 Pgs (S) PIN – 743376
		21. Sundarban Rural Development and Training Centre	Baidyabagan P.O.-Sukdevpur Dist.- 24 Pgs (S) PIN - 74503
		22. Uttar Champahati Tarun Sangha	Vill. & P.O.-Champahati P.S.- Baruipur Dist. – 24 Pgs (S) PIN – 743330
Uttar Dinajpur	**1**	**1. St John's Ambulance Association**	

Source : WBPCB

Apart from these enlisted NGOs in our state one Delhi-based NGO named **The Energy and Resources Institute (TERI)** has been included in the list of WBPCB for its impressive work. The address of TERI is : Darbari Seth Block, India Habitat Centre, Lodhi Road, New Delhi, 110003.

The WBPCB has selected the NGOs analysing their various activities and ability to protect nature and to save environment. These NGOs, located in every district of West Bengal, play a pivotal role to spread environmental awareness at the district level. Primarily they help communicate the mandates of the WBPCB to people throughout the state. For this purpose the enlisted NGOs are being trained continuously in various aspects of environmental pollution. They, in turn, address environmental issues of much concern among people, e.g., restricted use of plastic carry-bags, controlling and combating different types of pollution, conserving biodiversity and preserving wetlands etc.

In order to boost over-the-year performance of the NGOs, the WBPCB has declared to give Environment Excellence Award to those who have played an applaudable role in protecting the environment and have helped improve the conditions of living. Three NGOs got the 'Environment Excellence Award 2004' in the 'service sectors including NGOs' from WBPCB. The recipients were 'Gontra Samabaya Krishi Unnayan Samity Ltd'. And 'Lokmata Rani Rashmoni Mission' (joint first), 'Madhyamgram Green Manch' (second) and 'Lok Seva Parishad' (third).

With a view to cater administrtive and technical understanding of the core environmental issues, these enlisted NGOs were trained in groups by the WBPCB officials. The officials provided them with some important knowledge on pollution related issues at state, national and international level.

Moreover, with a bid to spread environmental awareness and to communicate WBPCB's message to people of the state, a 'Convenor NGOs System' consisting of 16 NGOs was introduced last year by WBPCB. These 16 convenors NGOs of different districts of West Bengal, out of 148 enlisted and registered NGOs, are :

1. Hooghly Mass Education Society (Hooghly)
2. Lokmata Rani Rashmoni Mission (24 Pgs.- S).
3. Chanchan Ganakalyan Samity (Malda).
4. Matri-O-Sishu Bikash Kendra (Howrah).

5. Birkota Rural Development Organisation (Paschim Medinipur)
6. Global Environment Research Foundation (Nadia).
7. Gobardanga Renaissance Institute (24 Pgs.-N).
8. Durgapur Citizens' Development Centre (Burdwan).
9. Indian Institute of Training & Development (Kolkata).
10. My Dear Trees & Wilds (Bankura).
11. St. John's Ambulence Association (Uttar Dinajpur).
12. Bivisonpur Three Star Club (Purba Medinipur)
13. Dharaninagar Rural Development Society (Birbhum).
14. Alipurduar Nature Club (Jalpaiguri).
15. Palsa Pally Unnayan Samity (Murshidabad).
16. Institute of Training & Development (Purulia).

The aforesaid convenor NGOs in each district of West Bengal essentially function as liason with other enlisted NGOs of the WBPCB as well as with other NGOs of the area, local clubs, organisations and educational institutions of the district. The promotional task of mass environmental awareness should be done by organising meetings at street corners and market places, by conducting seminars and debate sessions etc. in association with other NGOs and local clubs as well as institutions.

It is seen that in the environmental campaign strategy and to promote mass awareness the local school children are the most suitable and effective communicators as they have very free access amongst local populace. In this task the convenor NGOs help communicate the current environmental issues of much concern and its associated statutory restrictions, such as strictures on the use of plastic carry bags, especially in the ecologically sensitive areas, prevention and controlling of air, water and noise pollution, proper management of industrial, municipal and clinical waste, wetland, forest and biodiversity conservation.

In West Bengal there are several other NGOs in different districts apart from the WBPCB's enlisted NGOs. These NGOs today are functioning in various fields. In the sphere of environmental and alternative movement the role of these NGOs is undoubtedly noteworthy. Particulars of some of these notable NGOs are given in tables – 4, 5 and 6.

Table - 4

NGOs Working in Various Fields

Dis-trict	Total No. of NGOs	Name	Address	Field of Work	Activity
24 Pgs. (N)	**19**	**1. Bade Khantura Bahumukhi Seva Kendra**	Govinda Mondal (Secretary) Khantura, Gobardanga 24 Pgs. (N) Pin – 743 273	a) Social welfare, b) Education, c) Organise indoor games, debates, various cultural programmes, d) Help and promote, cottage industry, diary, pigery etc.	a) Run a computer training centre, b)Improved chullah, c)Participated in National Environment Awareness Campaign, d)Awareness generation for rural poor women, e)Immunisation programme, f) Run a charitable Homeo-dispensary.
		2. Barasat Unnayan Prostuti	Ranjit Kr. Dutta (Secretary) Basundhara, Noapara, Barasat,	a) Income generation, b) Self employment, c) Health education, d) Education,	

			Dist : 24 Pgs. (N) Pin : 743 707 Ph. 2542 1334	e) Agricultural training, f) Self drinking water, g) Environment, h) Publishing utility magazine	
		3. Basirhat Bijyan Sanstha	C/o Dr. N. Das Dept. of Zoology, Basirhat College, PO : Basirhat College Pin : 743 412 Dist 24 Pgs (N)		
		4. Chatra Kalyan Samity	Vivekananda Samaj Seva Kendra, P.O. & Vill : Media Block-Swarupnagar, Pin : 743 273 Dist : 24 Pgs (N)		
		5. Gobardanga Renaissance Institute	Sunil Biswas (Secretary) P.O. Khantura P.S. Habra, Dist : 24 Pgs (N),	a) Education, b) Publish useful literatures, papers etc. c) Organise lectures, seminars etc. d)Community	a) Participated in national Children Science Congress '99 at Goa, b) Attended the Science Club Conference held on

			Pin : 743 273, West Bengal	development, e) Organise science club and association, f) Social welfare, g) Training programmes, h) sanitation and health programme, i) Help and promote cottage and home industries.	23/24.01.1999 at Narasingha Dutta College, Howrah, c) participated in Water Resource (Environment) Clean Programme, d) Training programme, e) Organise seminar, f) Organise summer science hobby camp, science & technology fair, g) Education
		6. Ichapur Janakalyan Parshad	Anandamath 'A' Block, Ichapore, P.O. Nawabganj, Dist : 24 Pgs (N) Pin : 743 144		
		7. Janakalyan Binapani Club	Sudhangshu Chakraborty (Secretary) P.O. : Media Vill : Rabindra Nagar, Dist : 24 Pgs (N) Pin : 743 273	a) Games & sports, b) Cultural programme, c) Social welfare, d) Sanitation programme, e) Adult Education, f) Pollution control.	

		8. Jharkhali Mahila Mongal Samity	PO: Jharkhali Bazar Dist : 24 Pgs (N), Pin : 743 312		
		9. Jirakpur Sister Nivedita Seva Mission	Ramesh Sarkar (Secretary) Vill : Jirakpur, P.O. Basirhat Rly. Station, Dist. : 24 Pgs (N), Pin : 743 414	a) Social welfare, b) health care, c) Education, d) Agricultural development, e) Village welfare, f) Training programme.	
		10. Jugal Kishore Palli Unnayan Sangha	Ghouza, Dist : 24 Pgs (N), Pin : 743 249.		
		11. Milan Mitali	160/1, S. N. Banerjee Rd. Barrackpore, Dist : 24 Pgs (N), Pin : 743 101		
		12. National Environmental Awareness Centre	4/139, Jatin Das Nagar, Belgharia, Dist : 24 Pgs (N)		

		13. Sahara Utsarga Welfare Society	Sudipta Banerjee (Secretary) Banerjeepara, Dist : 24 Pgs (N), Pin : 743 296, Ph : 2567 1205 Fax : 2567 2940	a) Agricultural development, b) Training programmes, c) Promote cottage industries, power loom, hand loom etc. d) Education, e) Public health.	
		14. Uttar 24 Pargana Samaj Kalyan Samity	Jayanta Aditya Roy (Secretary) Vill & P.O. –Ghoshpur, Maslandapur, Dist : 24 Pgs (N).	a) Establish training centre, b) Help the handicapped people, c) Organise a mobile medical team,d)Education.	a) Health camp for the poor people, b) AIDS awareness camp, c) Development of self help group, d) Pollution control awareness camp, e) Training programme.
		15. Bijnan Darbar	Joydev Dey, 585 Ajoy Banerjee Road, P.O. Kanchrapara Dist : 24 Pgs (N) Pin : 743 145 Ph : 2585 6032	a) Environment protection, b) Pollution control, c) Public health, d) Publish useful literatures, e) Organise seminars, lectures etc. f) Science popularization programme.	a) Programme on Arsenic pollution, b) Save wetland programme, c) Science popularization programme, d) Publish literature, tabloid etc. e) Organise seminar, workshop etc. f) Public health, g) Awareness programme

		16. West Bengal Govt. Pensioners' Association	Dr. P. R. Gupta Ashokenagar, Habra Unit, Saheed Sadan Road, P.O. Ashokenagar, Dist : 24 Pgs (N).	a) Promote the interest and welfare of all the pensioners, b) Publish useful books, pamphlets, literatures etc. c) Social welfare.	
		17. Comprehensive Area Development Service	Shri M. K. Banerjee (Chairman) 5/2 R.B.C. Road, P.O. Naihati Dist : 24 Pgs (N), Pin : 743 165 Ph : 2581 3073	a) Maintain Library, b) Social Welfare, c) Health, d) Adult Education	a) Awareness camp, b) Income generation programme, c) Women welfare, d) Health Programme.
		18. Hizlia Janakalyan Samity	Sk. Kutubuddin (Gen. Secretary) Vill. Hizlia, P.O. Ashoknagar, Dist North 24 Pgs. Pin 743222 Phone 03216258366	a) Social Welfare b) Training programme c) Promote & cottage Home Industries d) Medical Activities e) Education	a) Medical Activities b) Children Education c) Organized Seminar d) Awareness Programme e) Cultural Activities f) Child & women Development

		19. Shyamnagar Voluntary Eye, Dead-body Doners,and Philanthropic Society	Jnanendre Nath Muzumder P.O.Basinti,Dist.South 24Parganas,pin743 312.	a) Improvement of village economic structure,b)Social welfare,c)Serve the poor and distressed people.	a) Awareness Programme, b)Self help group, c)Organise seminer, d)Training programme.
24 P g s. (S)	**29**	**1. Basanti Khadi & Village Industries Society**	Janendra Nath Mazumdar P.O. basanti Dist. South 24 Pgs. Pin 743312	a) Improvement of Village Economic Structure b) Social Welfare c) Serve the Poor and Distressed people	a) Awareness Progeamme b) Self Help Group c)Organise Seminar d)Training Programme
		2.Chandanngar Palm & Date Gur Products Artisans Welfare Society	Vill. & P.O. Chandanagore P.S. Diamond Harbour Dist: South 24 Pgs. Pin 743368		
		3. Dwip Shyamshree Sangha	Abbas Uddin Mola (Secretary) Vill: Dwip(Chawghari) P.O: Ghotakpur	a) Organise, Senars lectures etc., b)Publish useful literatures etc., c)Social welfare, d)Education, e)Collect &preserve manuscripts,	a)Awareness programme, b)Social welfare & relief, c)Economic programmes.

			Dist: South 24 Pgs Pin: 711205 Ph:(03174)260344	paintings etc. f) Alleviate the sufferings of animals.	
		4.Ganesh Chandra Sarkar Smriti Sangha	Shyamal Kr. Sarkar (Treasurer) Vill: Panchaghara, P.O: Khakurdaha Dist: South 24Pgs	a)Smokesless hearth b)Cultiovation extention project, c)Environment pollution,d)Nourishment & child education,e)Training Programmes f)Social work g)Aforestation,h)Family planing	
		5. Indian Institute of training and Development	Jnan Prokash (Chief Coordinating Officer) Srijani, P.O. Joka Thakurpukur, Dist. South 24 Pgs.	a) Community Development b) Training Programmes c) promote Self reliance d) Public Health e) Education f) organize meeting , Conference etc. g) Environmental Pollution	a) Primary health care b) NGO Management c) Malaria Prevention & Control. D) Community Health Development e) Water Sanitation & Hygiene f) Environmental awareness map.
		6. Kankjole Pally Unnyan	Md. Sirazul Molla (Gen Secretary)	a) Publishing literatures, magazines etc. b) Animal	

		Samity	Vill : Kanjole P.O. Maheshwera Dist. South 24 Pgs. Pin 743368.	husbandry, c) Education, d) Social Welfare	
		7.Kulpi Gramin Nari kalyan Samity	P.O. Bagaria Dist. South 24 Pgs. Pin 743332		
		8. Kundey Social Welfare Centre	P.O. Bagaria Dist. South 24 Pgs. Pin 743332		
		9. Lokmata Rani Rashmoni Mission	Ahindra Roy (Gen Secretary) P.O. Nimpith Ashram, Nimpith, Dist. South 24 Pgs. Pin 743338 Ph. 22487161	a) organize Seminars, b)Social Awareness c)Health awareness d)Pollution Control e)Cultural activities f) Self Employment Programme g) Training Programme	
		10. Mohanpur Chaitali Sangha	Sasanka Sekhar Paul (Secretary) Vill : Mohanpur P.O. Aryapara	a) Social Welfare b) Publishing literatures. c) Community Developement	

			Dist. South 24 Pgs. Pin 743377	d) Animal husbandry, e) Education,	
		11. Neogirat Aikatan Gram Unnyan Samity	Syed Nasiruddin (Secretary) Vill Neogirat P.O. Chauluary P.S. Falta Dist. South 24 Pgs.	a) Environment awareness b) health c) Hygiene, Women & Child Welfare d)Education f) Organise Seminar g) Social forestry.	
		12. Paschim Kumirmari Sucharita Smriti Sangha	Subash Chandra Mondal (Secretary) P.O. Kumirmari Narendrapur, P.S. Gosaba, Dist. South 24 Pgs. Pin 743378	a) Education b) Organise seminars, lectures,debates etc. c) Social Welfare, d) Promote cottage industries, e) literacy programme, f) Agricultural development , g) Women Development, h) Family Planning i) Training Programme	a) Education b) old-age home c) Health Programmes d) Awareness programme e) Landshaping and pond culture f) Low cost housing, g) Plantation Programme, h) Improved smokeless chullah, i) Training programme
		13. Paschim Bangha Vigyan Mancha	South 24 Parganas District Committee, Ashis Ghosh, Nilachal Complex, Nayanika Complex, Nayanika Appartment, Flat No. E/2,	a) Community water supply b) Sanitation c) health d)Education e) publication of Journals, books etc. f) Science Popularisation programme	a) Social Science project, b) Comprehensive area development survey c) Rural Science & Technology Centre, d) Improved Chullah,

			South 24 Parganas, Ph. 24770982		e) Sanitory mart, f) Panchyat level Resource mapping g) Agro clinic h) Low cost building i) water reserve Conservation j) Medicinal plant k) Environmental Mapping l) Arsenic mitigation programme m) Supervision and Monitoring of Health Care Waste Management Programme, Eco-Club projects in Schools.
		14.Purba Bhawanipur Polly Mangal Samity	Faruque Ahmed Chowdhury (Secretary) Vill. Purba Bhwanipur P.O. Morigachi Dist. South 24 Parganas. Pin 743368	a) Social Welfare, b) Organise Meeting. Seminar etc, c) Sanitation & safe drinking, d) Health care, e) Social Forestry f) Pollution Control, g) Self Employment, h) Cottage & small scale industry.	a) Low cost sanitation, b) Seminar on various aspects, c) Training Programmes, d)Installation of Bore Wells, e) Construction of low cost house, sanitary latrines, f)Smokeless Chullas g)Awareness Programmes, h) Children welfare & health care, i) Pollution Control, Literacy Programmes.

		15.Shatmonisha Santi Sangha (Mohila Samity)	Lutfa Khatun (Secretary) Vill. Shatmonisha P.O. Basuldanga Dist: South 24 Parganas Pin: 743368	a) Education b) Organise Lectures, seminars, etc. c) Social Welfare d) Animal Husbandry	
		16. Su-Chinta Mohila Samity	Umme Kulsum (Secretary) Vill. Dakshin Chaughari, P.O. Jaliabati, Dist. South 24 Parganas Pin 743336	a) Organise lectures, debates, seminars etc. b) Pulish useful literatures magazines etc. c) Education, d) Collect and preserve manuscript etc.	a) Literacy drive campaign, b) Drinking water awareness camp, c) Rural health programme, d) Self help group, e) Training programmes.
		17. Sundarban Nary Kalian Samity	Vill : Bally, P.O.: Bally, Hatkhola , P.S. Gosaba,, Dist. South 24 Parganas, Pin: 743 329		
		18 Sundarban Agroeco & Socio Educational Society	Nirmalendu Sarma (Secretary) Nanacheri, P.O. Canning Town Block – Canning-I, Dist: South 24 Parganas, Pin:743 329	a) Development of rural agro-economy, b) Socio-education, c) Vocational training, d) Child Care, e) Organise family counseling centre, f) Awareness generation programme for women, g) Training programmes, h) Environment conservation programme.	a) Social development work, b) Awareness camp, c) Education, d) Improved chullah, e) Organised pulse Polio camp, f)Awareness camp on pollution control, g) Low cost latrine.
		19. Sundarban Human Resource Centre	Susanta Kr. Dhara (Secretary) Kalinagar, P.O.: Diamond Harbour,	a) Social welfare, b) Organise lectures, debates, seminats etc. c) Education,	a) Education programme, b) Health programme, c) Environmental awareness programme,

			Dist : South 24 Parganas	d) Philanthropic activities, e) Training programmes, f) Women and child welfare.	d) Participated in National Environment awareness Programme, e) Women and youth development, f)Organise workshops, seminars etc. g) Sustainable agriculture programme.
		20. Tripurapur Milan Tirtha	Soumen Kr. Kayal (Secretary) Ph. 2470 0741 Vill: Tripurapur P.O. Gopalpurhut P.S. & Via: Galta, Dist: South 24 Parganas, Pin: 743 504	a) Education, b) Charitable dispensary, c) Organise seminar, lecture etc. d) Publish useful literatures etc. e) Literacy programme, f) Collect and preserve manusctipts, paintings etc.	a) Family welfare programme, b) Charitable health centre, c) Health awareness programme, d) Animal health programme, e) Literacy programme, f) Education, g)Self employment training, h) Formation of self help group, i) Social service, j)Rehabilitation for the handicapped.
		21. Universal progressive Study &	Baikunthapur, Jadav Sarkar Rd. P.O. Rajpur, Dist: South 24 Parganas.	a) Education b) Publishing brochure, newsletter, periodicals etc.,	

		Culture		c) Training, d) Ecology	
		22. Yuba Sammiloni	P.O. Jaynagar, Mojilpur Dist. South 24 Parganas Pin: 743 337		
		23. Narayan Smriti Sangha	Shri Bishnupada Parua (Secretary) Vill. + P.O. Madhusudan Chak, Dist. South 24 Parganas,	a) Health, b) Education, c) Social Welfare, d) Promote cottage Industry, e) Women Welfare.	a)Social forestry, b) Village Welfare, c) Env. Awareness Camp, d) Seminar, e) Adult Education, f) Social Welfare.
		24. Sunderban Rural Development and Training Centre	Shri Ranajit Manna (Secretary Ph: 2470 9079 Email: srdtc@cal2.vsnl.net.in. Baidyabagan, P.O. Sukdevpur, South 24 Pgs. Pin 743 503	a) Social Welfare b) Training Programme, c) Child Development d) Publish Journals e) Women Development	a) Ponds Excavation Programme b)Environment Pollution c) Seminar, d) Training Programme e) Technical Capacitation, f)Participated in National Env. Awreness Campaign. g) Veterinary Programme.
		25. Basantapur Young Star	Shri A.R. Gaji (Secretary) Vill. Basantaput,	a) Publish literature book etc. b) Organise seminar	a)Education, b) Community Health

		Club	P.O. Chandhagar. South 24 Pgs. Pin: 743 368	debates, c) Social Welfare d) Animal Welfare, e) Philanthropic activities.	c) Participated in National Env. Awareness campaign. d) Social Dev., e) Training.
		26. Sabuj Sangha	Shri Ansuman Das (Secretary) Nandakumarpur 743 349, South 24 Parganas West Bengal		
		27. Sonarpur Bon Hooghly social Welfare Organisation	Shri Khokon Sardar (Secretary Vill. & P.O. Bon Hooghly, 24 Parganas (South) (Via-Narendrapur) Ph: 2477 0902		
		28. Canning Swanirbhar	Shri Aparesh Chandra Mondal (Secretary) Vill : +P.O. Nikarighata, Dist. Sout 24 Parganas. Pin. 743 329	a) Training Programme, b) Promote Small Scale & cottage Industry.	a) Educational Programme, b) Health Programme, c) Training Programme, d) Awareness campaign e)Family welfare

					programme
		29. Amra Sabai	Genesh Ch. Das (G. Secretary) Kailashpur P.O. Nandakumarpur, Dist.South 24 Parganas, Pin 743 349 Email amrasab@dte.vsnl.net.in	a)Social welfare, b) Training programme, c) Health and sanitation programme, d) Youth welfare, e) Family planning, f) Labour welfare, g) Promote economic development.	a) Educatin and child development programme, b) Community health and safe motherhood programme,c) Income generation programme, d)Sanitation Programme.
BANKURA	**2**	**1. Khadi Pratisthan**	Vill & P.O. Kanuri, P.S. Saltora Dist. Bankura		
		2. Pashim Banga Vigyan Mancha	Bankura Dist. Committee, C/o. N. Bhowmik, Circus Maidan Dist. Bankura, Pin: 721 101 Asit Kr. Bhowmik, Natun Chati, Circus	a) Community water supply, b) Sanitation, c) Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved

			Maidan, Bankura, Pin 722 101. Ph (03242) 252023		chulah, e) Sanitory mart, f) Panchayet level Resource Mapping, g) Agro clinic, h) Low cost building, i) Water Reserve Conservation, j)Medicinal plant, k)Environmental Mapping, i)Arsenic mitigation programme, m)Supervision and Monitoring of Health Care, Waste Managent Programme, Eco-Club progect in schools.
BIRBHUM	**2**	**1.Nawapara Lakshminarayan Khadi-o-Gramonnayan Mahila Sanstha**	Kaberi Banerjee & Kamala Chaterjee (secretary) P.O.-N. Mahadwipa, Via – Sainthia, Dist. – Birbhum, PIN - 731234	a) women development, b)Village welfare c) Training programme, d) Organise seminar, workshop etc. e)Health, f) Education g) Sanitation.	a)Awareness programme b)Pollution control, c)Formating of self help group, d) Training programme, e) Health and hygiene programme

					h)Education i) Organise seminars, workshops etc.
		Paschim Banga Vigyan Mancha	Birbhum District Committee, C/O Sanat Sutradhar Ph: 953462255110 And Sanat Sutradhar Principal, Bolpur collage, Birbhum, Pin: 731204	a) Community water supply, b) Sanitation, c)Health d) Education, e)Publication of journals books etc. f) Science popularization programme	a)School science project b) Comprehensive area development survey, c) Rural science & Technology centre Margram d) Improved chulah, e) Sanitory mart f) Panchayet level resource mapping , g) Agro clinic h) Low cost building, i) Water reserve conservation j) Medicanal plant, k) Environmental Mapping , l) Arsenic mitigation programme m)Supervision and Monitoring of health care, waste management programme, Eco- club project in schools

BURDWAN	6	**1. Akabpur Sammelani**	G.B Mandal P.O : Nadanghat Dist: Burdwan Pin : 723515 Ph: (03454)260250 (03472)240911	a)Handloom projects, b)Irrigation projects c)Campaign d)Awareness programmes e)pollution control	
		2. Avijan Gosthi (Burdwan)	Samiran Chowdhury (Secretary) 105 G. T. Road Dist: Burdwan Pin: 713101 Ph: 2565703	a) Social welfare, b) Organise physical culture, sports competition etc. c) Education, d) Publishing literatures, magazines etc. e) Conduct programmes related to public awareness, f) Health programme,	
		3. Durgapur People's Science & Cultural Forum	Ashoke Chakraborty (G. Secretary) 6/3 Maxmullar Path, City Centre, Dist.-Burdwan,	a) Fight against supersitions, b) Organise seminar, workshopetc. c) Publish useful literatures etc.	a) Nature Study camp, b) Publish journal, c) Observation of world environment day and aranya saptaha, d) Project

			PIN - 713216 Ph : (0343) 2571313	d) Education, e) Plantation programme.	on Ambient Air quality Monitoring in traffic intersections and industrial areas of Durgapur sponsored by WBPCB, d)Campaign programme on usage of plastic, e)Organise seminar on 'Learning of Science'.
		4. Paschim Banga Vigyan Mancha	Burdwan District Committee, Banabas Kutir, Barabazar, Burdwan Pin : 713 104 & Srirup Gopal Goswami, Banabas Kutir, Barabazar, Burdwan, Pin: 713 104, Ph : (95342)256247	a) Community water supply, b) Sanitation, c)Health d) Education, e)Publication of journals books etc. f) Science popularization programme	a)School science project b) Comprehensive area development survey, c) Rural science & Technology centre Margram d) Improved chulah, e) Sanitory mart f) Panchayet level resource mapping , g) Agro clinic h) Low cost building, i) Water reserve conservation j) Medicanal plant, k) Environmental

					Mapping , l) Arsenic mitigation programme m)Supervision and Monitoring of health care waste management programme, Eco- club project in schools
		5. Kellarmath Sagar Gramin Mahila Samity	Shri Moly Kayal (Secretary) Vill. Chapatala, Block Purbasthali II P.O. Bargachi, Dist. Burdwan	a) Socio Eco Welfare b) Vocational Training c) Agro Economic Programme d) Awareness Generation Programme	a) Sanitation, b) Control of Pollution c) Children and women welfare d) Health
		6. Midnapore Netaji Rural Women Development Society	Ms. Nilima Santra (General Secretary) Vill + P.O. Akanndabari, P.S. Nandigram, W.B.		

COOCHBIHAR	1	**1. Paschim Banga Vigyan Mancha**	Coochbihar District Committee, C/O Ashim Saha, Atithinibash, Sunity Road (Kachari More), P.O. & Dist : Coochbihar, Pin : 736 101 & Asim Saha, PBVM Atithinibas, Suniti Road, (Kachari More), P.O. & Dist : Coochbihar, Pin : 736 101, Ph : (03582) 225842/225775	a) Community water supply, b) Sanitation, c)Health d) Education, e)Publication of journals books etc. f) Science popularization programme	a)School science project b) Comprehensive area development survey, c) Rural science & Technology centre, Margram d) Improved chulah, e) Sanitory mart f) Panchayet level resource mapping , g) Agro clinic h) Low cost building, i) Water reserve conservation j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme m) Supervision and Monitoring of health care waste management programme, Eco- club project in schools

HOOGHLY	**10**	**1. Arabinda Pally Bharat Kristi Seva Sangha**	Radheshyam Mali (Secretary), Office : 92,S.C.Chatterjee Street, Cosmos Apartment, Konnagar, Hooghly – 721 642. & 265, Arabinda Pally, Konnagar Hooghly – 721 642, Ph : 2674 6407 E-mail : ngo_bharatkristi@123india.com	a) Anti drug programmes, b) Environment, c) Non formal Education, d) Pollution Control	
		2. Bandhu Cornea Kendra	Swapan Kumar Bandhu (Secretary) 50, Rajendra Avenue Uttarpara, Hooghly, Pin : 712 258 Ph – 26634178 / 8003 / 3262 / 2225 4120	To establish an eye bank, b) Campaigns to build awareness about the necessity and importance of donating eyes, c) Health care, d) Social welfare, e) Organise seminars,	a) Eye donation camp, b) Awareness camps in primary schools, c) Health care programmes, d) Participated in Environment Awareness Map.

				lectures etc. f) Anti-drug programme, g) Intergrated child development project, h)Pollution control, i)Awareness building programme,	
		3. Bhadrakali Socio-Ecocultural Center For The Development Of Women And Children.	80A, BR.B.G.T.Road Bhadrakali Hooghly, Pin : 712 232.		
		4.Champdany Vigyan kendra	7P.C.S.Lane, P.O. Bhadreswar Dist-Hooghly, Pin:712 124		
		5. Chandannagar Science Club	91 A.C.Chatterjee Lane, (Jogipara), P.O.Chandannagar, Dist-Hooghly, Pin:712 136		
		6.Ispat Sangha	Nichupatty, Chandannagar, Dist : Hooghly.		

		7. Kanada Science Club	Ranajit Chatterjee (Secretary) 13, Dewanji Bagan, Majher Rasta, P.O. Chinsurah Dist : Hooghly Ph : 2680 0623	a)Enviroment improvement, b) Solar energy, c) Social development.	
		8. Paschim Banga Vigyan Mancha	Bhabani Joardar, Hooghly District Committee, 141. B.B.D.Road, P.O. Hind motor, Hooghly, Ph : 2673 3271/0790	a) Community water supply, b)Sanitation, c)Health, d)Education, e)Publication of journals, books etc. f)Science popularization programme	a)School science project, b)Comprehensive area development survey, c)Rural Science & Technology Centre, Margram, d) Improved chulah, e) Sanitory mart, f)Panchayat level ResourceMapping,g)Agro clinic, h)Low cost bulding, i)Water Reserve Conservation, j)Medicinal plant, k)Environmental Mapping, l) Arsenic mitigation programme,

					m) Supervision and Monitoring of Health Care, Waste Management Programme, Eco-Club project in schools.
		9.Radhanagar Pally Samity	Basudeb Basu (Secretary)Vill:Radha nagar, P.O. Nangulpara, Dist: Hooghly, Pin:712 406. Ph☹953211)266246	a) Developmenp of education and culture, b) Organise debates, lectures seminars etc. c) Social welfare, d) Agricultural development, e) economic development.	a)Education, b)Heath and hygiene programme, c) promote art and craft, d)Women welfare, e) village welfare, f) Participated National environment Awareness Programme, g) Solar power training.
		10.Taraknath Maternity and Child Welfare Centre	Sanat Kr. Mullick (Administrative officer) P.O. Tarakerswer, Dist : Hooghly, Pin : 712 104 Ph : 9112 276448	a) Health care, b) Child care, c) Development of human resources, d)Training programmes, e) Social service, f) Small scale and cottage industries.	

HOWRAH	**19**	**1. Azad Hind Samity**	Vill & P.O. Bainaan, Dist : Howrah		
		2. Curup	Belanagar P.O. Abhoynagar P.S. Bally Dist : Howrah Pin : 711 205		
		3. Gondalpara Sree Maa Mohila Uddyoge	Arati Chakraborty (Secretary) Vill & P.O. Gondalpara, Dist : Howrah, Via – Andul Mouri, Pin : 711 302	a) Training programme, b) Adult education, c) Exhibition, d) Campaign programme.	
		4. Jujersha Women & Child Welfare Organisation	Archana Mandal (Secretary) P.O. Jujersa, P.S. Panchla, Howrah Pin : 711 302	a) Women welfare, b) Socio economic programme, c) Training programme, d) Child welfare, e) Education, f) Social welfare, g) Public health.	a) Educational programme, b) Training programme, c) Economic programme, d) Mother and child health care, e) Smokeless chullah, f) Environmental awareness.

		5. Khajuri Jana Kalyan Kendra	Md. Fazlul Islam Sardar (Gen. Secretary) Vill – Khajuri P.O. Burikahli P.S. Bauria, Dist : Howrah Pin : 711 310	a) Organise lectures, b) debates etc., c) Publishing literatures, magazines etc. d) Community development, e) Health zone.	
		6. Mahishamuri Pallimangal Samity	Aditya Kumar Maji (Gen. Secretary) Vill : Mahishamuri, P.O. Nowpara, Dist : Howrah, P.S. Amta, Pin : 711 401. Ph. (9114)220295, (953214)220295, (03214) 220295	a) Awareness programme, b) Environmental awareness campaign, c) Water body cleaning, d) Plantation, Pollution control, e) Agricultural development, f) Health	
		7. Manasri Tarun Bani Mandir	Bimal Kr. Chakraborty (Secretary) P.O. Uttar Manasi Dist : Howrah Pin : 711 412	a) Education, b) Child care, c) Social forestry, d) Health awareness, e) Child immunization, f) Training programme.	

		8. Matri -O - Sishu Bikash Kendra	Alpana Chatterjee (Secretary) Vill : Garmirjapur P.O. Mashila Dist : Howrah Pin : 711 412	a) Social welfare, b) Adult education, c) Community development.	
		9. Natibpur Nabin Sangha	Vill : Natibpur, P.O. Kolorah, Dist : Howrah, Pin : 711 411		
		10. Paschim Banga Vigyan Mancha	Shibani Sinha Howrah District Committee, Red Cross Bhavan 5, Mahatma Gandhi Road, Howrah – 711 101 Ph : 2651 3729	a) Community water supply, b) Sanitation, c) Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme	a) School science project, b) Comprehensive area development survey, c) Rural science & Technology Centre, Margram, d) Improved chulah, e) Sanitory mart, f) Panchayat level Resource Mapping, g) Agro clinic, h)Low cost bulding, i)Water Reserve Conservation, j) Medicinal

					plant, k) Environmental Mapping, l) Arsenic mitigation programme, m) Supervision and Monitoring of Health Care, Waste Management Programme, Eco-Club project in schools.
		11. Rajibpur Youth Union	Lakshmi Kanta Das (Secretary) Vill : Rajibpur, P.O. Uttar Durgapur, Dist : Howrah, Pin : 711 312	a) Youth welfare, b) Sanitation and public health programme, c) Education, d) Help the distressed.	a) Child welfare, b) Leprocy programme, c) Rural welfare, d) Health programme, e) Safe drinking water, f) Consumer awareness camp, g) Vocational training, h) Women and youth welfare, i) Social forestry, j) Pisciculture.
		12. Ranmahal Asha Gramin	S.L. Rahaman (Secretary)	a) Education, b) Vocational training programme,	a) Health care service, b) Education for children,

		Development Society (RAGDS)	Vill : Ranimahal, P.O. Dhulasimla, Dist : Howrah, Pin : 711 315	c) Health programme, d) Promote home and cottage industries, e) Organise lectures, debates etc. f) Community development, g) Social welfare, h) Relief work, i) Awareness programme, j) Family planning.	c) Awareness camp, d) Income generation activities, e) Social welfare.
		13. SAVE (Society for Advancement of Village Environment)	Karoona Kanar (Secretary) 23/2 Kshetra Mitra Lane, Salkia, Howrah – 711 106	a) Social welfare, b) Organise lectures, debates etc. c) Publishing useful literatures, papers etc. d) Community development, e) Sanitation and health programme, f) Health care programme.	a) Family planning, b) Mother and child health care, c) Immunization programme, d)Awareness programme on STD/HIV/AIDS, e) Programme on nutrition, f) Rural welfare, g) Plantation progrmme, h) Parcipated in Environment awareness map project.

		14. Shyampur Adarsha Gram Bikash Kendra	Abdul Rafique (Secretary) Vill : Tajnagar, P.O. Amardaha, P.S. Shyampur, Dist : Howrah, Pin : 711 312	a) Social & cultural advancement, b) Training programmes, c) Publishing magazines, leaflets etc. d) Education, e) Nutrition programmes, f) Animal husbandry, g) Health.	a) Education, b) Library, c) Health programme, d) Environment protection, e) Organise seminar on environment and agriculture, f) Income generation programme, g) Irrigation programme.
		15. The Friends' Club	Jyotirmoy Mukherjee P.O. G.I.P. Colony, Vill : Jagacha, Dist : Howrah, Pin : 711 321 Ph : 2657 7141/1906	a) Organise library, night school, b) Organise seminar, lecture etc. c) Social services.	a) Drama competition & cultural function, b) Vocational training, c) Rehabilitation of women in distress, d)Organised seminar /workshop, e) Distributed fitting equipment for the disabled.
		16. Village Welfare Society	A.K.Maity (Secretary) P.O. Pancharul, Dist : Howrah Ph. 2564 6545/5786 E-mail : vws@cal3.vsnl.ne.in	a) Empowerment of women, b) Micro credit activity, c) Pre-primary education, d) Income generation activity, e) Old age home, f) Day care	a) Micro credit activity, b) Old age home, c) Child guidance centre, d) Consumer awareness, e) Environmental awareness, f) Traffic

				centre, g) Computer training programme.	awareness programme, g) Alternative agriculture, h) Anti drug programme.
		17. Agradut Polly Unnayan Samity	Shri U. S. Mukherjee (Secretary) Vill & P.O. – GAZA, Dist : Howrah, Pin : 711 226, Ph : 9114 257254	a) Education, b) Organize Lecture Debates c) Health Activities d) Adult Education e) Social Welfare	a) Sanitation b) Awareness Programme c) Housing d) Rain water harvesting e) training Programmes
		18. Yuba Unnayan Seba Samity	Shri Sibobrata Majee (Secretary) Vill & P.O. Tehatta P.S. Ulberia, Via Panchila Dist. Howrah (W.B.) 711 322, Ph : 2661-6359	a) Social Welfare b) Cultural Activities c) Health Activities	a) Social Welfare b) Training Programme c) Self-Help Programme d) Organised Seminar e) Street children education f) Participated in National Env. Awareness Campain.
		19. Pakuria Friends association	Shri Swapan Kr. Jana (Secretary) Ekshara (Sitaltala), P.O. Chamrail, Dist : Howrah, Pin : 711 323 (W.B.), Ph : 9112-249324/249224		

J A L P A I G U R I	3	**1. Alipurduar Nature Club**	Amal Dutta (Chairman) P.O. Alipurduar Court, Dist : Jalpaiguri, Pin – 736 122, Ph : (03564) 256440/ 258144 Fax no. (03564) 255511/ 258352	a) Care for nature, b) Conservation, c)Education d)Environment	
		2. North Bengal Alternative Energy & Rural Development Association	Dibendu Kr. Hira Vivekananda Bipanan Kendra, Race Course Para, (Room No 22) Jalpaiguri, Pin : 735 101	a) Training programme, b) Promote maximum utilization of biomass and solar energy, c) Community development, d)Improvement of natural environment, e) Rural development.	
		3. Paschim Banga Vigyan	Jalpaiguri District Committee,	a) Community water supply, b) Sanitation,	a) School science project, b) Comprehensive area

		Mancha	C/O Asoke Mitra, New Town, Dist : Jalpaiguri, Pin : 735 101	c)Health, d)Education, e)Publication of journals, books etc. f)Science popularization programme	development survey, c) Rural science & Technology Centre, Margram, d) Improved chulah, e) Sanitory mart, f) Panchayat level Resource Mapping, g) Agro clinic, h)Low cost bulding, i)Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme, m) Supervision and Monitoring of Health Care, Waste Management Programme, Eco-Club project in schools.

K O L K A T A	54	**1. BAM-INDIA**	Dr. Md. Hossain (Sr. Medical Officer) Garden Reach Community Health Programme J-483, Paharpur Road, Kolkata 700 024	a) Health care, b)Sanitation, c)Environment, d) Campaign programme	
		2. Baptist Development Society	Partha Roy (Secretary) 42/113, East End Park, Kolkata – 700 039	a) Organise physical and cultural programme, b)Social welfare, c)Education, d)Community development, e) Health care.	a) Non formal education centre, b) Health clinic, c) Veterinary programme, d) Mother and child care, e) Smokeless chullah, f) Income generation programme.
		3. Baranagar Social Service League	Shyamal Sarkar (President) 120/1/2, Maharaja Nanda Kumar Road, Baranagar (South), Kolkata – 700 036	a) Health programme, b) Animal husbandry, c)Campaign programme	

		4. Bharat Scouts and Guides (West Bengal)	State Secretary State Head Quarters, 5, Govt. Place North, Kolkata 700 001 Ph : 2248 3641		
		5. Bikash Bharati Welfare Society	B. Bhattacharya (Administrative Officer), 20/1B, Lalbazar Street, Kolkata – 700 001 Ph : 2243 1787/2210 4393 Fax : 2220 7270, E-mail. Bharati @ cal13.vsnl.net .in	a) Education, b) Social welfare, c) Training programme, d) Publishing, e) Promote higher education, f) Establish children sanatorium, hospital, counseling centres, g) Campaign & awareness programme.	
		6. Birati Mahajati Vidya Mandir.	Sankar Basu Majumder M.B.Road, Mahajati Nagar (I), Birati, Kolkata – 700 051 Ph : 2512 5340(O) 2512 3597®	a) Campaign programme, b) Environment, c)pollution control, d)Education	

		7. Birbhumi Women's Society	Purnima Bhattacharya (Secretary) 3/75 Mahajati Nagar, P.O. Birati, Kolkata – 700 051.	a) Publishing literatures, b)Social welfare, c) Rural development, d)Plantation, e) Irrigation, f) Environment development, g) Mother & child welfare, h)Education, i) Training programme	
		8. Birsingha Vidyasagar Society For Social Service	Bidyut Kr. Ghosh (Secretary) 10, P.K. Guha Lane, Dum Dum Cant, Kolkata – 700 028, Ph : 2511 8805	a) Education, b) Social welfare, c) Training programme, d) Awareness programme, e) Family counseling, f) Rural development.	
		9. Calcutta Urban Service Consortium	16, Sudder Street, Kolkata – 700 016. & Mihir Ghosh Dastidar (Secretary) B-8/6, Dankuni Housing Complex, Dankuni, Dist : Hooghly, Ph : 2246 9268/2249 7875 Fax : 2249 1732	a) Social service, b)Community service, c)Developmental work, d)Organise training programme, seminars, conferences etc. e)Publishing books articles etc., f) Education, g)Public health.	

		10. Central Bharat Sevak Samaj Life Workers Mission (North Kolkata Division)	10/1B, Marhatta Ditch Lane, Kolkata – 700 003.		
		11. Centre for Sustainable Development for Poor Settlers (Rural & Urban)	145/9, Baruipara Lane, Kolkata – 700 036.		
		12. Children's Paradise	Keya Roy Choudhury (Principal) 103, Diamond Harbour Road, Kolkata – 700 063	a) Awareness programme, b) Education, c) Organise seminar, workshop etc. d) Publish journals, magazines etc. e)Undertake ecological project, f) Environmental activities.	a) Education, b) Environment awareness programme, c) Nature study camp, d) Partcipated in National Environment Awareness Campaign, e) Training programme, f) Organise workshop, g) Sports and games.

			Kolkata – 700 087, Ph : 2245 9675 Fax : 2246 0521 E-mail : foset @vsnl.com	pinion, e)Promote R & D, f) Provide low cost housing, g) Sanitation, h)Environment.	
		20.Gana Unnayan Parshad	Sutapa Dewanji (Director) 10, Gomesh Lane, Kolkata – 700 014 Ph : 2246 8079/2403, E-mail : guplamp@cal.vsnl.net.in	a) Improvement of village economic structure, b)Undertke khadi and village industries programmes for creating employment opportunity, c)Served the poor and distressed people, d)Education, e)Community health programme, f)organise seminars, lectures etc.	a) Human resource development - Economic issues, b) Environment preservation & Ecological development, c) Community health programme, d) action for gender justices, e) Elimination of child labour programmes, f) Rural entrepreneurship development, g) Smokeless chullah, h) Low cost latrine, i) Rural sanitary mart programme
		21. Ganadarpan	D.N.Ghosh Road, Bhowanipur, Kolkata.		

		22. Ganavigyan Samannay Kendra	C/O Book Mark, Bankim Chatterjee St., Kolkata – 700 073.		
		23. Habitat Centre	27, Netaji Subhas Road, Kolkata – 700 001.		
		24. Indian Association	62, Bipin Behary Ganguly Street, Kolkata – 700 012		
		25. Institute Of Social Studies & Environment Education Committee	Nepal Sarkar (Gen. secretary) 23A, Netaji Subhas Road, 6th Floor, Room No. 15, Kolkata – 700 001, Ph : 2221 0623/2220 5421 Fax : 2335 5749	a) Organise seminar, lectures, etc. b)Environmental awareness, c) Plantation, d) Publication, e)Campaign programme, f) Training programme	
		26. Jadavpur Women in Need Organisation (W.I.N.)	Manabendra Dewanji (Secretary) 15/2/17, Jheel Road, Bankplot, Jadavpur,	a) Social welfare, b)Manage small scale production centres, c) study and assist street children, drug addicts,	a) Leadership development training camps for social activists, b) Seminar on women and environment,

			Kolkata – 700 075 Telefax : 2241 6983 Mobile : 98300 90277	d)Improvement of environmental quality, e) Conservation of natural resources, d) Organise seminars, workshops etc. establish and manage libraries.	c) Empowerment of women, d) Forest management in Purulia district, e) Legal education and aid programme, f) cancer control and awareness programme, g) Youth development programme, h)Awareness programme on AIDS, i) Anti pollution and eco-environmental conservation programme.
		27. Janasastha Committee	Anadi Dutta, 66, A.P.C. Road, Kolkata – 700 009, Ph : 2459 3927	Having no such Memorandum of the organization or article of the organization	a) Pulse polio immunization, b) Malaria eradication programme, c) Organise seminars, workshops etc. d) Organised Jana Swastha Mela, e) Organised first National

					Health Assembly at Salt Lake on and from 30.11.2000 to 01.12.2000
		28. Khadi Pratisthan	Asit Ranjan Das (Secretary), 15, College Square, Kolkata – 700 073, Ph : 2241 6510 Fax : 2673 0333	a) Training programme, b) Child welfare, c)Cultural programme, d) Social welfare, e) Handicrafts programme, f) Health, g) Mother & child care, h) Environment & social forestry, i) Environment awareness, j) Sanitation.	
		29. Liberal Association For Movement Of People (LAMP)	Malay Dewanjee (General secretary) Ph : 2241 8496/7469 Fax : 2241 6983 E-mail : guplamp@cal.vsnl.net.in	a) Mass education, b)Socio economic development, c) Provide medical facilities, d) education, e) Housing and shelter, f)Development of science and technology, g) Explore research and	a) Study and publication on socio economic problem, health etc. b) awareness generation programme, c) Educational programme, d) Environment education and awareness, e) Vocational training, f) Marketing assistance to

				documentation, h) Help old and disabled persons.	rural artisan group, g) Participated in National awareness campaign, h) Child health, i) Sanitary programme, j) Rehabilitation programme of leprosy sufferers, k) Social forestry.
		30. Milli Mission of Bengal	Dr. A. Rahaman (Gen. Secretary) 7/1 Jannagar Road, 1st Floor, Kolkata – 700 017 Tele ax : 2284 2742	a) Education, b) Social welfare, c) Environmental awareness	
		31. Naktala Centre For Socio-Economic Reforms And Environmental Conservation	Mrinal Kanti Bhattacharya (Gen. Secretary) 8, Naktala Road, Kolkata – 700 047 Ph : 2411 0496	a) Non-formal education, b) Natural resource management, c) Sustainable agriculture, d)Health awareness, e)Environmental programmes.	

		32. Nodal Research Centre	27, Baker Street Kolkata – 700 027		
		33. Norman Bethun Janasastha Andolan	10/A, Parshibagan Lane, Razabajar, Kolkata.		
		34. Paribesh Unnayan Parishad.	Dr. A. Mishra (Secretary) Golf Green Urban Complex, Phase – II, MIG – 2, Flat No. 4/19, Kolkata – 700 095 Ph : 2249 9908/09	a) Environmental education, awareness, protection, preservation and rejuvenation, b) Research, c) Publishing journals, literatures etc.	
		35. Paschim Banga Vigyan Mancha	C/o Sourav Chakraborty North 24 Parganas District Committee, "Sribhumi" 19, P.C.Ghosh Road, Kolkata 700 048 Ph : 2521 7645/2210 7606	a) Community water supply, b) Sanitation, c) Health, d) Education, e)Publication of journals, books etc. f)Science popularization programme	a) School science project, b) Comprehensive area development survey, c) Rural science & Technology Centre, Margram, d) Improved chulah, e) Sanitory mart, f) Panchayat level

					Resource Mapping, g) Agro clinic, h)Low cost bulding, i)Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme, m) Supervision and Monitoring of Health Care, Waste Management Programme, Eco-Club project in schools.
		36. Paschim Banga Vigyan Mancha	Utpal Dutta, Kolkata District Committee, Hemanta Bhaban (3rd Floor) 12, B.B.D.Bag, KOlkata – 700 001 Ph : 2413 0537/2210 5574	a) Community water supply, b) Sanitation, c)Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme	a) School science project, b) Comprehensive area development survey, c) Rural science & Technology Centre, Margram, d) Improved chulah, e) Sanitory mart, f) Panchayat level Resource Mapping, g) Agro clinic, h)Low cost

					bulding. i)Water Reserve Conservation, j) Medicinal plant. k) Environmental Mapping. l) Arsenic mitigation programme. m) Supervision and Monitoring of Health Care Waste Management Programme. Eco-Club project in schools.
		37. Prantik Jana Bikash Samity	Supti Pollary (Secretary) 163-E, C-Block, Salt Lake, Kolkata – 700 064, Ph : 2334 9158 Fax : 2249 3686 E-mail. Pivscal @ vsnl.net	a) Education, b) Child labour, c) Health, d) Nutrition, e) Income generating programme, f) Awareness programme, g) Vocational training, h) Plantation, i) Social welfare.	
		38. Ram Nagar Lane Forum Of Revolution For	Naushad Alam (Chief Functionary) J-94, Ramnagar Lane,	a) Education, b) Organise lectures, debates, seminars etc. c) publish	a) Non formal education, b) Nutrition programme, c) Training programme,

		Communities Education (R N L FORCE)	Garden Reach, Kolkata - 700 024, Ph : 2469 6679	useful literatures, magazines etc. d) Collect and preserve manuscripts, painting etc. e) Alleviate the sufferings of animals.	d) Organise seminar, workshop etc. e) Mother's counselling programme, f) Income generation programme, g) Awareness programme.
		39. Sastho-O-Paribesh	Krishna Chatterjee CD-327, Salt Lake City, Kolkata – 700 064 Ph : 2337 2063	a) Publish Useful literatures, magazines etc. b) Organise lectures, debates, seminars etc. c) Education, d) Literacy programme, e)Philanthropic activities, f) Alleviate the sufferings of animals.	a) Training programme, b) awareness programme on health and environment consciousness among the students, c) Rural development, d) Publish bimonthly journal "SASTHO-O-PARIBESH'.
		40. Society For Equitable Voluntary Actions(SEVA)	Asoke Ghosh (Secretary) 3C, Milan Apartment , 52/3 Vidyayatan Sarani, Kolkata 700 035, Ph : 2577 6365	a) Community development, b)Education, c) Social welfare, d) Environment	

		41. Song Of Unity And Liberty (SOUL)	Prabal Sarkar (Secretary) 28A, Ananda Palit Road, Kolkata – 700 014 Ph : 2216 2936	a) Social welfare, b) Children welfare, c) Health, d) Education, e) Women Empowerment, f) Awareness programme, g) Environment protection, h) Pollution control, i) Organise seminar, lecture, workshop etc. j) Training programme.	a) Street children welfare, b) Sustainable water management, c) Child health care, d) Awareness on HIV/AIDS/STD, e) Promotion of self help group, f) Awareness on environment and pollution control, g) Vocational training, h) Fish processing, i) Organise seminar, workshop.
		42. Spade	21, Jogendra Gardens, (Ground Floors) Haltu, Kolkata – 700 078		
		43. The Science Association of Bengal	Dr. S.Roychowdhuri (Secretary) 104, Diamond Harbour Road P.O Barisha Kolkatta- 70008 Phone:24472312 Fax: 24127278	a)Social Walfare, b)Training Programme, c)Organise Seminer workshop etc. d)Awereness Programme, e)Environment,	a)Participated in National EnvironmentAwareness Campaign,b)Computer Awareness programme c)Organised workshop for blacksmiths at

			11, Hindusthan Park, lansdown, Kolkata 700029		
		50. Basudha (Centre for New World)	Smt. Sadhana Ghosh (Gen. Secretary) T-11/A Dr. A.K.Pal Road (Extn), Behala Kolkata 700034	a) Social Welfare b)Organise Seminar c)Promote Education d)Training and rehabilitation e) Campaign against pollution	a) Activities for the Handicapped, b) Social Welfare c) Road Safety, d) Seminar on Horticulture e) Health f) Education
		51. Dum Dum Unmesh Welfare Organisation	Sri Prafulla Kumar Pal (Secretary) 23/2/23, Mali Road, Dumdum, Kolkata 700080, Ph. 2559-1113, 2559-3223	a) Awareness Programme b) promote a sense of integration c) Socio Economic Programme d) Publish useful literature, magazines etc.	a) Cultural Activities b) seminar, c) Plantation, d) Environment, e) Health f) Education.
		52. Nature Environment & Wildlife society	Biswajit Roychoudhury (Secretary) 117 Kamani Mansion, 25 A Park Street, Kolkata-700 016, Ph 2229-0079	a) Awreness Programme b) Undertake & soonsored scientific & Research Project c) Publish journals, bulleting, Newsletter etc.	a) Survey of flora & fauna of wetlands of West Bengal b) Survey of flora & fauna of Mahananda wildlife c) Problems of tiger straying in the

					villages of Sunderbans d) Survey of birds of Jaldapara wildlife anctuary e) Study on Food-Habit & Breeding behaviour of Indian Pied Hornbill.
		53. Behala Institute for Nature Study and Development	Shri Debabrata Goswami (President) 1/37/ Bijoygarh, Kolkata 700 032, Ph: 2447-7745	a) Rural Welfare, b)Educational programme, c) Social Welfare, d)Organize Campaign, e)Awareness Programme, f)Adult Education	a) Campaign Programme, b) Education c) Health d) Awareness Programme
		54 Mimic	Shri Ranen Chakraborty (Secretary) 38/57A, Minapara Road, Kol-700 092, Ph: 211 1241	a) Cultural Education	
MALDA	5	**1. 16 Mile Rural Development Society**	Md. Maimul Hoque (Secreatary) Vill. 16 Mile (Rail Coloney),	a) Social welfare, b)Organise lectures, seminars etc. c)publishing	a)Bee keeping b) Improved chullah, c) Self help group, d) Training

			P.O Gurutola,. Dist. Malda. Pin 732 127 Ph. (03512) 224138	useful literatures, papers etc. d) Literacy programme, e)Community development f) Animal husbandry, g)Philanthropic activities	programme, e) Community development f) Animal husbandry, g) Philanthropic activities. h)I)j)
		2. Bulbulchandi & Barind Development Society	Probal Lala (Secretary) Vill & P.O. Bulbulchandi, Dist: Malda. Pin 732 122	a) Education, b) Cultural Programmes. c) Social walfare, d) Health programmes, e)Campaign programme,	
		3. Paschim Banga Vigyan Mancha	Omkar Bannerjee Malda District Committee, C/o. Teachers Syndicate, Mukdumpur, Dist. Malda, Pin: 732 101 Ph: (03512) 250575/56988	a) Community water supply, b) Sanitation, c) Health, d) Education, e)Publicatin of journals books etc. f) Science popularisatin programme	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved chulah, e) Sanitory mart, f) Panchayet level Resource Mapping, g) Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal Plant, k) Environmental

					Mapping, i) Arsenic mitigatin programe, m)Supervision and Monitoring of Health Care, Waste Management Programme Eco-club poject in schools
	4	**S.M. Educational Society (S E M S)**	Khairunnesa Rahaman (Gen. Secretary) Vill: Solomile P.O: Gurutala, Block-Kalaichak III, Vai: Khejuriaght Malda	a) Educational programmes b) Family Planning and Orphanage c) Vocational and technical training d)Publish magazines, e)Health and Sanitation programme f) Communication development.	a) Educational activities, b)Medical camps c)Exhibition, seminars and women awareness camp, on HIV / AIDS, e) Skill training programme f) Assistance for disabled person g) Run a Homeo-clinic,h) Social and cultural programmes
	5	**Sanskriti –O- Samaj Unnayan Parishad**	Tarun Kr. Debnath (Gen Secretary) C/O Prof. Mitra Chakraborty Rabindra Pally, (New Krishna Pally Malda – 732101	a) Social Walfare b) Economic Development, c) Education d)Community health programme e) Safe drinking water programme f)Awareness programme.	a) Nonformal education b) Sanitary mart c) Micro – finance ,d) Sustainable agriculture, e) Disaster Preparedness, f) Farm pond excavation , g) Vocational training for

					women, h) Study of flood situation, i)Seminar on flood life and livelihood j)Participated in Environment awareness map project.
PASCHIM MEDINIPUR	1	**1. Birkota Rural Development Organisation**	Jitendranath Nayak (Secretary) Vill & P.O. Dasagram, Dist : Paschim Midnapore, Pin : 721 67.	a) Community development, b) Organise lectures, debates etc., c) Publishing literatures, d) Campaign programme, e) Women welfare, f)Child welfare, g) sanitation programme, h) Training programme.	

PURBO MEDINIPUR	**28**	**1. Bivisonpur Three Star Club**	Shyamal Kr. Samanta (Secretary) Vill & P.O. Bivisonpur, PS : Bhagwantpur, Purbo Midnapur, Pin : 721 458	a) Environment awareness, b) Sanitation, c) health programmes, d)Women & child development, e) social welfare	
		2. Changrachak Netaji Society	Nlini Ranjan Das (Secretary) Vill & P.O. Changrachak, Dist : Purbo Midnapore Pin : 721 644 Ph. (03228) 236247/260371	a) Smokeless chullah programme, b)environmental awareness c) Agricultural development, d) Training programme, e) Health.	
		3. Council For Rural Welfare	Amulya Maity (Gen. Secretary) P.O. Sabang, Dist : Purbo Midnapur Pin : 721 144	a) Rural development, b)Health programme, c)training programme, d)Education, e) Social welfare,	

		4. Deulichak Pally Unnayan samity	Dipak Roy (Secretary), Vill. Deulichak, P.O. Dabuapukur, Bollk – Panskura-I Dist : Purbo Midnapur Pin : 721 634, Ph : (03228)241345	a) Education, b)Publishing Magazines, c) Social welfare, d) Campaign programme, e) Child welfare, f) Charitable dispensary, g) Training programme	
		5. Gangadharchak & Dewanchak Vivekananda Club	Sibsankar Misra (Secretary) Vill : Dewanchak, P.O. Gangadharhak, Block – III, Dist : Purbo Midnapur Pin : 721 444 Ph : (03220)258127	a) Social welfare, b)Student care, c)Organise balwadi, orphanage etc, d)Organise games and sports, cultural functions, e) Literacy programme, f)Education, g) Print and publish journals, periodicals, h) Training programme, i) Rural development.	a) Run a day care centre for aged, b) Run a crèche and nursery school, c)Handloom training cum production unit, d)Partcipated in environment awareness campaign, e) Vocational training programmes, f)Plantation programme
		6. Gopiganj Social Welfare Organisation	Syed Munsur Ali (Secretary),	a) Education, b) Social welfare, c) Workshop-	

			Vill : Uttarbarh P.O. Kheput, P.S. Dasput, Dist : Purbo Midnapur Pin : 721 148, Ph : (953225)250370	Seminar, d) Mother & child care, e)Rehabilitation programme, f) Health programme.	
		7. H.R.D. & C.W.	Kukrahati, Haldia Purbo Midnapore, Pin : 721 658		
		8. Haldia Samaj Kalyan Parishad	Dulal Samanta P.O. Anantapur, Via Sutahata, Dist : Purbo Midnapur Ph : (03224) 281582/281581	a) Social welfare, b)Organise seminar, conference etc.c) Health programme, d) Awareness programme, e) Sanitation, f) Formation of Income generation Group, g) Low cost house.	a) Education. b) Cultural activities, c) Nutrition, health, hygiene, d)sanitation, e)Environment vocational training, f) Awareness programme, g) safe drinking water, h) Low cost house, i) Sanitary latrine, j) Income generation project.

		9.Haldia Vigyan Parishad	Asish Lahiri (Gen. Secretary), Vigyan Bhaban, PO : Haldia Township Dist : Purbo Midnapur Pin : 721 607, Ph : (03224) 263856/252900 Fax : (03224)263856 E-mail : webwl/123@dte.vn.net.in	a) Popularisation of science, b) Public health, c) Environment, d) Rural development, e) Training programme, f) Social welfare.	
		10. Integrated Rural Welfare Institute	Mihir Lal Dash (Chairman) Vill : Sunka, P.O. Fulgeria, Dist : Purbo Midnapur Pin : 721 437, Ph : (03222)231324	a) Awareness campaign on pollution control, b) Rehabilitation programme c) Women development, d) waste land development, e) Organise workshops, f)Health programme, g)Education.	
		11. Kalindi Tarun Sangha	Dipak Kr. Jana (Secretary) Vill & P.O. Kalindi, Block-Ramnagar-II	a) Social welfare, b) organise seminars, lectures, debates etc. c)Publishing literatures,	

			Dist : Purbo Midnapur Pin : 721 461	d)Education, e) Animal husbandry, d) Agricultural development, e) Social forestry, e) Pollution control.	
		12. Kaliswar Yuba Chatra Sangrami Sangha	Subhash Chakraborty Kaliswar, dehati, Dist : Purbo Midnapur Pin : 721 139	a) Socil welfare, b) Organise lectures, debate, seminars etc. c) Publish literatures, magazines, books etc. d) Child welfare, e) Community development, f) Taking necessary step for improve method of cultivation, poultry, pisiculture etc. g)Education, h) Socio-economic programme.	
		13. Kolaghat Loke Siksha Niketan	Somnath Ghosh (Secretary) Vill. Denan,	a) Education, b) Health, c) Hygiene, d) Training programme, e) Promote	a) Non-formal education, b) Awareness camp for women, c) Organise

			P.O. Amalhanda, P.S. Kolaghat, Dist : Purbo Midnapur Pin : 721 134	cottage industries, f) Organise lectures, seminars, g) Publish reports, books, magazines etc.	seminar on social issues, d) Organising women self help group, e) Agriculture and pisiculture development, f) Pollution control and environment protection.
		14. Kolaghat Science Hobby Centre	Tapas Das (Secretary) P.O. Kolaghat, Purbo Midnapur, Pin : 721 134, Ph : 9503221856451	a) Establish Pasteur Science Library, b) Publish science patrika, useful literatures etc. c)Organise science exhibition, d) Organise Science study centre, e)Training programme, f)Organise seminar free eye operation camp, g)Education.	a) Observation of World Environment Day and Forest Week, Science Day, b) Organise seminar, c) Blood donation camp, d) Science exhibition, e)Literacy movement.
		15. Maligram Rural Development Society	Ashis Mandal (Secretary) Vill : Maligram, P.O. Maligram, Dist : Purbo Midnapur Pin : 721 140	a) Social welfare, b)Organise lectures, debates, discussions, seminars etc c) Animal husbandry.	

		16.Mangalamaro Bazar Byabasai Samity	P.O. : Mangalamaro, Dist : Purbo Midnapur Pin : 721 434		
		17. Midnapore Cultural & Welfare Association	Nikhil Kumar Jana (Secretary) Kotebazar (Kamararah), P.O. & Dist : Purbo Midnapur, Pin : 721 101	a) Public education, b)Social activities, c)Training Programme, d)Publishing literatures, e)Organise seminars etc.	
		18. Midnapore District Council For Social Welfare	Chandan Kanti Utthasanee (Secretary) P.O. Egra Dist : Purbo Midnapur Pin : 721 429	a) Social welfare, b) Organise debates, lectures etc. c) Publish Papers, magazines etc. d) Cultural programme, e) Education, f) Socio-economic programme.	
		19. Nimbark Math Seva Samity Trust	S.S.Deb Mahanta (Secretary) Vill : Baikunthapur, P.O. : Sankarpur, Dist : Purbo Midnapur Pin : 721 211, Ph : (03225)254425	a) Education, b) Child health, c) Environment, d) Women development.	

		20. Paschim Banga Vigyan Mancha	Midnapore District Committee, "Mishra Bhavan" Arabindo Nagar, Purbo Midnapur, Pin : 721 102 & Tapan Mishra, Burge Town (Pora Bunglow), P.O. & Dist. Purbo Midnapur Pin : 721 101 Ph : 953222264331	a) Community water supply, b) Sanitation, c)Health, d) Education, e)Publicatin of journals books etc. f) Science popularisatin programme	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved chulah, e) Sanitary mart, f) Panchayet level Resource Mapping, g) Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal Plant, k) Environmental Mapping, i) Arsenic mitigatin programme, m) Supervision and Monitoring of Health Care, Waste Management Programme , Eco-club poject in schools
		21. Ramngar Unnayan Parishad	PO : Ramnagar, Dist : Purbo Midnapore, Pin : 721 441		

		22. Sarbik Gram Unnayan Sangha	Biswasjit Ghoroi (Secretary) Vill. Boalia, P.O. Baraibarh, Dist. Purbo Midnapore, Pin 721626	a) Social Welfare b)Training Programe	
		23. Alukaranbarh Seba Sangha	Surajit Bhattacharya P.O. Alukaranbarh, P.S. Bhupatinagar, Block Bhagwanpur-II, Contai, Purbo Midnapore, Pin 721454		a) Literacy Programme, b) Health camp c) Sports Programme d) Seminar e) Plantation
		24. Amar Seva Sangha	Balai Kishore Samanta, P.O. & Vill : Raine, Block Paskura-II Dist : Purbo Midnapur Pin 721130 Ph. (03228) 56214	a) Ambulance service b) Charitable dispensary c) Cultural Development, d) Handicapped rehabilitation, e)Pisciculture, f) Relief, g) Social Forestry, h) Social development i)Rural Library, j) Old age Home, k) Day Care Centre l) Mobile Medicare unit.	a) Run Old age home, b) Run a Day care centre c) Mobile Medicare unit d) Run Charitable dispensary e) Pisciculture f) Established a handloom production centre g) Sanitary Latrine h) Safe Drinking Water

		25 Amdan Mother Child Welfare and Handicapped Bikash Kendra	Bikash Chandra Patra Vill & P.O. Amdan, Haur, Dist. Purbo Midnapur, Pin 721131	a) Education b) Arrange seminar/workshop, c) Publishing d) Social Welfare e) Child Welfare f) Sanitation g) Training programes h) Campaign Programmes i) Agriculture	a) Education Centre b)run a rural child health centre c) Low cost latrine programme d) Smokeless Chullah e) participated in National Environment Campaign programme, f) Awareness camp on immunization, family planning , etc. g) Women development program h)Training Camps i)Agricultural development
		26 Asnan Ma Saradamayee Mohila Samity	Sandhya Pradhan (Secretary) Vill & PO – Asnan Dist. Purbo Midnapur Pin 721101 Ph. (03220) 255450 (R)	a) Social Welfare b) Non Formal Education, c) Child care d) Publishing literatures, journals etc. e) Fish-culture, bee-keeping, poultry etc.	
		27. Haldia Rural Development & Community Welfare	Shri Bijay Das (General Secretary) Vill : Ariakhali, P.O. Kukrahati, Dist : Purbo Midnapore,		

			Pin : 721 658 Ph : 03224-289556		
		28. Norai Ramchandrapur Sarbik	Shri Biswanath Patra (Secretary) Gram Bikash Kendra, P.O. Upalda, Dist. Purbo Midnapore	a) Educational programme, b) Organize lecture, debates etc., c) Publish useful literature, d) Animal Welfare, e) Philanthropist Activities, f) Women Welfare	a) Educational programme, b) Cultural Activities, c) Child help programme d) Smokeless choola e) Awareness campaign f) Women Development Programme g) Agricultural programme.
MURSHIDABAD	**2**	**1. Chatra Physically Handicapped & Social Welfare Institue**	Achintya Kr. Shil (Secretary) P.O. Chatra, P.S. Islampur, Via – Daulatabad, Dist : Murshidabad Pin : 742 302	a) Child welfare, b) Handicap welfare, c) Education, d) Rural welfare, e) Social welfare, f) Awareness programme, g) Organise seminar etc., h) Training programme.	

		2. Paschim Banga Vigyan Mancha	Murshidabad District Committee, C/O Tapan Samanta, 31/1 Amar Chakraborty Road, Nabanagar, P.O. Khagra, Dist : Murshidabad, Pin : 742 101 & Dr. Samsujjaman Ahmed, 75/14/A, K.P.Chattaraj Road, P.O. Berhampur, Murshidabad, Pin : - 742 101 Ph : 953482 253285/2574002	a) Community water supply, b) Sanitation, c) Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme.	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved chulah, e) Panchayet level Resource Mapping, g) Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme, m) Supervision and Monitoring of Health Care Waste Management Programme, Eco-Club project in schools.
N A D I A	**5**	**1. Jatrapur Rural Development Society**	Debashis Garai (Secretary) Vill : Jatrapur, P.O. Jaypur, Dist : Nadia,	a) Social welfare, b)Organise sports competition, c) Publishing literatures etc. d) Health programmes, e)	

			Ph : (03472)235296, 953472235296	Environment Awareness	
		2. Karimpur Social Welfare Society	A.K. Sarkar (Secretary) Tarakdas Road, P.O. Karimpur Dist : Nadia Pin : 741 152 Ph : (03471)255060	a) Publishing literatures magazines etc. b) Animal husbandry, c) Education, d) Social welfare	
		3. Paschim Banga Vigyan Mancha	Nadia District Committee, C/O Santanu Jha, B-11/83, Kalyani, Nadia Pin : 741 235 & Aniruddha Das, B-14/339, Kalyani, Nadia, Pin : 741 235, Ph : 2582 3392	a) Community water supply, b) Sanitation, c) Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme.	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved chulah, e) Panchayet level Resource Mapping, g)Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic

					mitigation programme, m) Supervision and Monitoring of Health Care Waste Management Programme, Eco-Club project in schools.
		4. Rail Gate Babasai Sameettee	1 No. Fulia Rail Gate, Fulia Colony, Dist : Nadia, Pin : 741 402		
		5. Bhabanipur Kumudini Smriti Seva Shram O Sikshya Niketan	Shri Nirapada Biswas (President) P.O. Bagula, East Nadia, Pin : 741 502	a) Literacy programme, b) Promote cottage industry, c) Training, d)Socio Economic Programme, e) Women Welfare, f) Exhibition	a) Health programme, b) Sanitation , c)Education, d) Women Welfare, e) Training Programme, f) Smokeless Chullah.

UTTAR DINAJPUR	1	**1. Paschim Banga Vigyan Mancha**	North Dinajpur District Committee, C/O Anjan Majumdar Raiganj Diagonostic Laboratory, Super Market, P.O. Raiganj, Uttar Dinajpur, Pin : 743 134 Ph : (03523) 252833/252968	a) Community water supply, b) Sanitation, c) Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme.	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved chulah, e) Panchayet level Resource Mapping, g) Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme, m) Supervision and Monitoring of Health Care, Waste Management Programme, Eco-Club project in schools.

DAKSHIN DINAJPUR	1	**1. Paschim Banga Vigyan Mancha**	Amitabha Ghosh South Dinajpur District Committee, Gangarampur Dakshin Dinajpur Ph : (03521)256170	a) Community water supply, b) Sanitation, c) Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme.	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved chulah, e) Panchayet level Resource Mapping, g) Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme, m) Supervision and Monitoring of Health Care Waste Management Programme, Eco-Club project in schools.

P U R U L I A	1	**1. Paschim Banga Vigyan Mancha**	Niranjan Mahato, Nistarini College, Purulia District Committee, P.O. & Dist : Purulia Pin : 723 101, Ph :, (03252)222064	a) Community water supply, b) Sanitation, c) Health, d) Education, e) Publication of journals, books etc. f) Science popularization programme.	a) School science project, b) Comprehensive area development survey, c) Rural Science & Technology Centre, Margram, d) Improved chulah, e) Panchayet level Resource Mapping, g) Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme, m) Supervision and Monitoring of Health Care, Waste Management Programme, Eco-Club project in schools.

DARJEELING	1	**1. Paschim Banga Vigyan Mancha**	Gopal Dey, Darjeeling District Committee, Kanchanjungha Stadium, Gate No. 7, Siliguri, Darjeeling, Pin : 734 406, Ph : (0353)2561564	a) Community water supply, b) Sanitation, c)Health, d) Education, e)Publication of journals, books etc. f) Science popularization programme.	a) School science project, b) Comprehensive area development survey, c)Rural Science & Technology Centre, Margram, d) Improved chulah, e) Panchayet level Resource Mapping, g)Agro clinic, h) Low cost building, i) Water Reserve Conservation, j) Medicinal plant, k) Environmental Mapping, l) Arsenic mitigation programme, m)Supervision and Monitoring of Health Care, Waste Management Programme, Eco-Club project in schools.

Source : WBPCB

NGOs Working on Environment (Table – 5)

Name	Address	Field of Activity
1. Economic Rural Development Society	Madhu Basu, 6, Kiran Sankar Roy Road Ground Floor, Room No.- 3 Kolkata –1.	Rural area development in agriculture, adult education, health, housing , small irrigation.
2. Indian Society for World Life Research	Tathagata Bhattacharjee 122/8 Southern Avenue, 2nd floor, Kolkata – 29.	Wildlife survey in forests of West Bengal, Orissa, Assam, Arunachal Pradesh and Madhya Pradesh.
3. Institute of Public Health Engineering India	Sisir Neogi 1, Garstin Place, Kolkata – 1.	Healthcare, spread of education, development of slums, housing sewage, agriculture.
4. Himalayan Science Association	K.K.Tamang, Darjeeling Govt. College, Darjeeling.	Socio - economic development, afforestation, training in science and environment.
5. Jalpaiguri Science and Nature Club	Nayabasti (Near Power House), Jalpaiguri.	Health, education, agriculture, sewage, housing .

6. Nandarampur Jagannathpur Vidyasagar Club	Purba Shrikrishnapur, Sutahata, P.O.- Haldia, Dist. – Purbo Medinipur	Rural development in education, healthcare and sports, training in environment.
7. School of Fundamental Research	Biplab Bhusan Basu 49B, Tollyganj Road, Kolkata – 26.	Non-formal education, science awareness, environment.
8. Science Centre	S.K.Pan Golkuachak, Purbo Medinipur.	Training in science and environment.
9. Abhoy Ashram	Khitish Roychowdhury Balarampur, Purbo Medinipur.	Rural development in education, culture, economy, health and sewage.
10. Akbarpur Sammilani	Haidar Ali Seikh, Nadanghat, Dist.- Burdwan.	Afforestation, safe drinking water, wetland , agriculture.
11. Basirhat Bijnan Samstha	Prof. N.Das Depth. Of Zoology, Basirhat College, 24 Pgs (N).	Training in Science and environment.
12. Bengal Natural History Society	B. Dasgupta Darjeeling Govt. College, Darjeeling.	Making of natural history museum.
13. Botanical Survey of India	Sital Ch. Adhikary,	Maintaining ecological balance,

Employees' Association	1, Sadar Street, Kolkata – 16.	promote awareness regarding environmental degradation.
14. Centre for Regional Ecology & Science Study in Development Alternative	Chaturanga, Plot No.-3, 32 Gobinda Addy Road, Kolkata - 27	State-wise training and research in human development.
15. Centre for Study of Man and Environment	A.K.Saha, Deptt. of Geology, Presidency College, Kolkata - 73	Environmental information gathering, inter-disciplinary research programme.
16. Children's Paradise	Kalyan Roy Chowdhury 103, D.H. Road, Kadamtala, Kolkata	Promotion of awareness in environment and science among children and youths.
17. Citizen Volunteers' Force	P.Das 2/1A Siddheswari Ch. Lane Kolkata	Promotion of environmental awareness
18. Concern for Calcutta	Sibani Afegar 103, Tivoli Court, Ballyganj Circular Road, Kolkata -19	Environment-oriented activities in Kolkata.
19. Development Research Communication and Service Centre	Ajoy Chowdhury Gariahat Road, (South), Kolkata – 31	Environment-oriented activities.

20. Forum for Development of Inter – Disciplinary	Dilip Basu 11/U Jhil Road, Kolkata – 75.	Environment-oriented activities in Kolkata, 24 Pgs(N) & (S).
21. Gram Seva Sangha	Dulal Ch. Pal Sachin Kar Gupta Path Hatthuba, Habra, 24 Pgs.(N).	Environment-oriented activities in 24 Pgs(N) & (S).
22. Indian Coucil of Rural Youth	P.R.Dey 4/2, Kolkata – 61	Afforestation, Seminar and other activities on environment.
23. Indian Rural Medical Association	34, Sashi Bhusan De Street Kolkata – 32	Promotion of awareness regarding pollution and AIDS.
24. Institute for Motivating Self-Employment	Biplab Halim, 244 Jodpur Park, Kolkata – 68.	Environment – related activities, documentary on AIDS.
25. Jana Siksha Prachar Kendra	R.P.Mukherjee 57B, College Street, Kolkata-73.	Environment – oriented activities.
26. Nikil Bharat Banobasi Panchayat	Raj Ram Singh Jhargram, Paschim Medinipur.	Environment – oriented activities in West Bengal and Jharkhand.
27. NO More Bhupal Committee	R. Samaddar 64 C.R.Avenue, Kolkata-12.	Environmental pollution.

28. Rural Development Consortium	Robin Mukherjee AD 239, Salt Lake City Sector – I, Kolkata – 64.	Environment-related activities.
29. Sarbik Gram Vikash Kendra	Narayan Bhai Dihibai, Daspur, Medinipur, PIN – 721211.	Development and environment - related works.
30. Seva Varati	J. Chatterjee Kapgari, Medinipur.	Seminar on resource conservation, making of gobar gas plant.
31. Tagore Society for Rural Development	M. Sadhukhan 14 Kshudiram Bose Road Kolkata – 6.	Conservation of nature, development of rural people.
32. Chitrabani Society	1, Rafi Ahmed Kidwai Road Kolkata – 17.	Making of documentary for promotio of environmental awareness.

Source : Chetana, 2001

NGOs Working for Women and Rural Development (Table – 6)

Name	Address	Field of Activity
1. All Begal Women's Union	89, Eliot Road, Kolkata –17	Production oriented training centre, self-employment, shelter for poor, aged women and sex-workers

2. All India Progressive Women's Association	31/1/1 Creek Row Kolkata – 14	Legal counselling centre for oppressed women
3. All India Women's Conference, West Bengal	Mrs. Rekha Chatterjee AD 263/8, Sector – II Salt Lake City, Kolkata – 64	Training centre for handicrafts
4. All India Women's Conference Kolkata	539/A, Block – N, New Alipur, Kolkata – 53	Counselling centre for oppressed and drug addicted women
5. Anima Pally Mangal Samty	G.Banerjee Ania, Hooghly, Ph. 22410222	Women's rights, education, healthcare, rural and slum development
6. Amra Gori Juva Sangha	Enaul Haque Vill- Asbabri, Dt.- Howrah PIN – 711401	All India medical camp, child health and education, training of tailoring, free distribution of books to children
7. All India Council for Mass Education and Development	R. Biswas (Director) 60 Potuatala Lane, Kolkata, -Ph. : 2241 1778	Child education, economic Development, family welfare and planning, rural development and environmental pollution
8. All Bengal Mass Education and Development Association	Dr. S. Adhikari (Director) Sr. Scientific Officer & Lecturer, 48/8 Civil Row Kolkata, Ph.: 25552397	Spread of Mass Education

9. Alakendu Bodh Nikentan (Residential)	Dr. A.K.Ghosh Executive Council member P1/4/1, C.I.T. Scheme, V-11-M, V.I.P. Road Kakurgachi, Kolkata – 54	Child education, vocational training
10. Agragati	U.Dolui P.O.-Raspur, Amta, Howrah T.Mondal, 51/1 Panchanantala Road Howrah, Ph: 26503758	Housing development, child health and education, sewage, human rights, vocational training centre for women, rural population, environment
11. Alipara Matsyajibi Unnayan Samity	S.Chowdhury Vill.-Alipara, P.O.-Meherpur Kaliachak, Malda	Pisciculture, rural population
12. A.I.W.C Golf Green Constituent Branch	S-2/1, Golf Green, Kolkata Ph.: 24731296	Health, education, human rights, environment.
13. Action Research Institute	K.L.Bhowmik 47D, Palm Avenue, Kolkata	Employment generation, marketing training for women and aged persons, shelter for homeless.
14. Ananda Samity	18B, Lansdown Street Kolkata – 29	Training of tailoring and food processing for women.

15. Ankur Kala Women's Centre	9A Meher Ali Road, Kolkata -17	Production oriented training for women.
16. Association for Protection of Democratic Right	18, Madan Baral Lane, Kolkata – 12, Ph.: 22764596	Legal counselling for tortured women.
17. Accord	Samarendra Nath Mukherjee (Executive Director) 8 C.B.Road, Anandapuri, P.O.-Nona Chandanpukur, Barrackpore, Dist.- 24 Pgs.(N), Ph.: 24690262	Socio-economic development of tribes and downtrodden, aged people, women and children, employment generation for poor women, self employment, rights of children and child-labour.
18. Abhoy Ashram	B.L.Bhattacharjee Project Manager 324/1 M.B.Road, Birati, Kolkata – 51,Ph.: 25394196	Health, self-employment, environmental pollution, slum development, agriculture, technological assistance.
19. Agrani Sangha & Pathagar	S.R.Paria P.O.-Pharijalanbar, Egra – 11 Purba Medinipur	Rural Economic development, housing development, education, forest resource; employment generation, human rights.
20. Asha Welfare Society	A.K.Maity Shree Ganesh Nagar, Namkhana, 24 Pgs.(S).	Health, rural population, slum, youth and women development.

21. *Ashoka India*	*Susmita Ghosh* 188/3/1A Prince Anwar Shah Road, Kolkata – 45, Ph.: 24172587	Employment generation, urban & rural population, vocational training, development programmes.
22. Ashokegarh Society for Human Welfare	'Single Point" 144 Ashokegarh, Kolkata – 35	Childcare and health.
23. Antoranga	Sucharita Sil 114 B Sehinpur Road Ph.: 24732488	Rural children health, education, population, AIDS.
24. Arambag Adarsha Pally Samaj	Vill & P.O.- Arambag, Dist.- Hooghly	Children, non-conventional energy generation, sports biotechnology, women, tribes and rural population.
25. Association for Social Health in India	Smt. Panna Roy 9 Asoke Avenue, Kolkata – 47 Ph.: 24711599	Homeless people, education, health, women development, rehabilitation of sex workers.
26. Association of Voluntary Blood Donors, West Bengal	20 A Firdous Lane, Kolkata – 14 Ph.: 22271022 / 24732405	Community service, health and education, rural population, voluntary blood donation, campaign against superstitions.
27. Azad Welfare Society	Mahiuddin Shah Project operator, Vill – Saapara, P.O.-Suvarar, Dist. – Howrah	Employment generation, non-conventional energy conservation, health, income generation, safe drinking water, rural population, women development.

28. Ballyganj Upasana Development Society	27, East Gate Kasba Rathtala, Kolkata –78, Ph,:24425129	Shelter for women victims in natural disasters and riots.
29. Bengal Home Industries Association	57, Chowranghee Road, Kolkata – 71,Ph.:22424062	Handicrafts and cotton weaving centre for women, selling counter.
30. Bengal Mass Education Society	99/14, Bidhan Sarani, Kolkata – 4, Ph.: 22412240	Legal counselling and help and vocational training for tortured women.
31. Brahma Samaj Mahila Bhaban		Shelter for girls above 11 years, vocational training centre.
32. Bakul Sports Association	D. Samanta (Secretary) Vill & P.O.- Bazkul, Medinipur	Children, health, income and employment generation, marketing and production-oriented training centre, rural population, area development.
33. Balarampur Vinodini Mahila Sangha	Kanika Roy (Secretary) Balarampur Colony P.S.- Balarampur, Murshidabad	Training in tailoring and handicrafts, sports, self-sufficient handicraft centre for women.
34. Bangiyo Unnayan Parishad	Raktim Mukherjee (Director) 29 Valley Park, 180 Kanungo Park, Kolkata, Ph.: 24628159	Literacy campaign, promotion of science, technology and culture, training centre for scientific agriculture, handicrafts, cottage industries.

35. Bahitara Kshudra Purbachal Janakalyan Sangha	D.K.Jana Vill- Bahitara kund, Medinipur, PIN – 721401	Rural child-education, agro-development, family welfare and planning, health, promotion of awareness regarding malnurition/ undernutrition.
36. Baikunthapur Arun Sangha	S.Giri Baikunthapur, Via Roy Dighi, Kestopur, Sundarban Dist. – 24 Pgs. (S).	Homeless people, forest resources, housing development, education, income generation, environment, driking water, rural population.
37. Baltikuri Vikash Bhaban	Santi Chakravorti (Secretary) Baltikuri Bahar, P.O.- Baltikuri, Dist.- Howrah	Health, income generation, nutrition, self-sufficiency of women.
38. Banga Varati Mihir Sevasram	Dr. M. Jana (Director) Vill – Narayanpur, Namkhana, Dist.- 24 Pgs.(S)	Rural homeless people, economic development, income generation, vocational training centres, handicrafts development, socio-economic development for tirbes & downtrodden.
39. Netaji Seva Sangha	M.Samanta (Secretary) Vill- Berabei, Mednipur	Child-education, economic and enterprise development, health, forest resources, housing development, human rights,

		rehabilitation of tribes and downtrodden,safe drinking water, women development.
40. Beradapi Social Welfare Institution	Sanjib Bhattacharjee Vill & P.O- Beradabi, E.Station, Block-2, Diamond Harbour, 24 Pgs(S)	Treatment for drug addicted people, education, environment, housing development, safe drinking water, income generation, rural population women development, rural vocational training.
41.Beranalgeria Silpa Sangha	Vill-Beranalgeria P.O- Athati,Medinipur, Pin-721422	Child and rural development.
42.Bankura Institute	Dr. H.Ghosh, Pratap Bagan, Dist-Bankura	Rural and economic development for children, alternative energy, environment, forest resources, health, nutrition, population, pollution development and research, sewage, slum, tribe and income generation.
43. Barasat Pally Unnayan Samity	Arup Bhattacharjee, Narsingpur, P.O-Chotajagulia, Barasat Sadar, 24Pgs (N)	Child, health, income generation, women development, safe drinking water, training of tailoring.

44. Berani Binapani Sangha	S.K.Shaw, Vill-Berani, P.O. Satsile, Dist-Mednipur, Pin-721422	Literary campaign through different projects for rural development, health, primary education, pisciculture, affortestation, training for rural organisations.
45. Barabari Sarodamoni Matri Mangal Samity	M.Samanta, Baraberia, Medinipur, Pin-721430.	Education, health, training for tribes.
46.Bare Footed Doctor's Service Centre	S.Nandi (Secretary) A-7/13,Diamond Park, P.O.-Joka, 24Pgs(S), Pin-743512.	Education,health, employment generation, rural population, sewage.
47. Beluni Janakalyan Sangha	Block-Kulpi, P.O.- Dolhigh, 24 Pgs (S),Pin-743512.	Rural Child-health, education, development for women and youths.
48. Bengal Rural Welfare Service	S.Goswami (Project-in-Charge), 279 Kendua Main Road, Kolkata- 84 Ph :24326064/24623229	Adult education, child and women health, family planning, development for domestic animals.
49. Berhampur Pradhan Sava	P.Roychowdhury (Secretary) 19/17, Amar Chakraborty Rd,	Homeless people, health, research and development on socio-economic

	P.O-Khagra, Dist-Murshidabad Pin-742103.	conditions of aged rural people.
50. Bhabanipur Multipurpose Rural Welfare Society	Bansari Chandra, Vill-Bhabanapur, P.O-Chitrasenpur,Howrah	Education, forest resources, training of tailoring for women.
51. Bhandarhati Pragati Samstha	S.Banerjee (Secretary) Vill-Bhandarhati, Dist-Hooghly,712301.	Child, health, education, forest resources, development for women.
52. Bharat Nirman	M.S.C. Bhandari (Convener),4 Sonyog Street, Kolkata, Ph: 22421503/24126077.	Conservation of alternative energy, environment, health, safe drinking water, human resources developemnt, agriculture.
53. Bhatband Mahila Samity	Sibani Neogi (Secretary), P.O & Dist-Purulia, 723101.	Education, rural population, agriculture.
54. Voruka Public Welfare Trust	Dr.Asha Rao (Directors), 83 Rafi Ahmed Kidwai Road, Kolkata-16. Ph:22449619/22456859/ 22961196.	Health, legal aid, campaign against AIDS, medical camps to develop blood bank.
55.Vikram Nagar Udayan Sangha	A.K.Bag (Secretary), Vill-Vikramnagar,P.O.Haria, Medinipur,Pin-721431.	Rural children, homeless people, education employment generation, house-building, aid for handicrafts, income generation.

56. Kolkata Legal Aid . Committee	City Civil & Session Court Building,2/3 Kishanganj Roy Road, Kolkata-700 001 Ph:22484833.	Legal counselling and shelter for tortured women.
57. Kolkata Municipal Corporation Slum Development Cell	C.M.C Building, 3rd Floor, 5, S.N.Banerjee Road, Kolkata – 700 013. Ph: 22443471.	Sewing, making of leather and electrical goods, tailoring, flood processing, computer training, toy & doll making.
58. Kolkata Port Trust Officewise Association	P-92 Helen Keller Sarani, Kolkata – 53.	Shelter
59. Kolkata Rescue Home	279/3, N.S.C Bose Road, Kolkata – 23	Shelter.
60. Calcutta Social Project	172/3, Rashbehari Avenue, Kolkata – 29. Ph: 24663693.	Shelter, training of handicrafts and Cottage industries.
61.Cathedral Releif Service	Cathedral Road, Kolkata – 71. Ph:22237947.	Tailoring and serving, making of candle, chalk, book binding.
62. C.I.T Working Women's Hostel	51/C, Ramakanta Bose Street, Kolkata – 3	Hostel for unmarried working girls whose homes are outside of Kolkata.
63. City Health & Welfare Association	14 Parsi Bagan Lane, Kolkata – 9 Ph: 23502483.	Counselling centre for tortured, mentally disabled women.

64. Control of Vagrancy	Purto Bhawan, Salt Lake City, Kolkata – 92. Ph: 23344522.	Shelter for vagabond women over 18 years.
65. Development Dialogue	19 Sarat Chatterjee Avenue, Kolkata – 29, Ph:24667387	Counselling centre and shelter for tortured girl child and sex-worker.
66. Durbar Mahila Samonnoy Committee	8/2, Bhabani Dutta Lane, Kolkata – 73. Ph : 22416283/6200	Counselling centre for sex-workers, their family members and clients.
67. Gano Unnayan Parishad	10, Gomes Lane, Kolkata –14, Ph : 22468079/2403.	Shelter for tortured women.
68. Institute for Motivating Self-Employment	244 Jodhpur Park, Kolkata – 64. Ph: 24732740,24779147. Shelter at – IMSE, Vill-Malancha, P.O.Suri, Dist – Birbhum.	Shelter for tortured women.
69. La Martin Society	U.N.Brahmachari Street, Kolkata – 37, Ph : 2240053.	Training in handicrafts and cottage industries.

70. Institute of Social Work	29B Chetla Central Road, Kolkata – 27, Ph :24796607.	Legal aid for tortured women.
71. International Mission and Rope Society	2 Nimak Mahal Road, Kolkata – 13. Ph :24792519.	Counselling for tortured women, Centre for adoption.
72. Jana Siksha Prachar Kendra	57B College Street, Kolkata – 73. Ph : 2244 3324.	Shelter for helpless women and sex-workers, production oriented training programme.
73. Jataya Mahila Samhati	201 Prince Golam Md.Road, Kolkata – 26. Ph : 24640939.	Shelter for low income women, tailoring, machine embroydery training.
74. Jeevika Development Society	Vill- Samali, P.O.- Royhazari, ThakurPukur, Bakrahat Road, 24 Pgs (S)	Training centre for handicrafts and cottage industries.
75. Joint Women's Programme	13 Elgin Road, Kolkata – 21. Ph : 24749945.	Legal counselling for tortured women.
76. Karmakutir	P-8 Gariahat Road, Kolkata – 19. Ph :24640176.	Training centre for handicrafts and tailoring.
77. Light House of The Blind	174 F.P.Mukherjee Road, Kolkata – 26. Ph : 24664227.	Training of telephone operating for women, making of paper box, candles.

78. Legal Aid and Advice Society	1 Kiran Shankar Roy Road, Kolkata – 1.	Legal counselling for tortured women.
79. Lutheran World Service	23/7, Murari Pukur Road, Kolkata – 26. Ph : 24664227	Night-Shelter for homeless women.
80. Mahila Seva Samity	8 Govt Place, Kolkata – 1. Shelter at Vill-Gazipur, P.O. Bazpur, Sonarpur, 24Pgs (S).	Shelter, legal aid, training centre.
81. Mass Education	Mahamayatala, Garia, Kolkata – 84.	Shelter for tortured women, education for orphan children, handicrafts training.
82. Nabadiganta	29 Banerjee Para Road, Kolkata – 61.	Counselling for adoption handicrafts centre old-age home, Yatri Niwas, Shelter for vagabond boys and girls.
83. Nari Nirjatan Pratirodh Mancha	29/1 A, Old Ballyganj Second Lane, Kolkata – 19. Ph : 22402480.	Legal counselling centre for tortured women.
84. Nari Seva Sangha	1/1/2A, Gariahat Road (S), Jodhpur Park, Kolkata – 68. Ph : 2473-3978.	Shelter for poor unmarried women, divorced helpless women and socio-economically backward women, centre for tailoring, handicrafts, book binding, shorthand type for women

85. Nari Siksha Samity	294/3, A.P.C Road, Kolkata – 9, Ph : 23504884.	Training Centre for handicrafts.
86. National Federation for Indian Women's West Bengal Committee	10/C, Prince Anwar Shah Rd, Kolkata – 700 045.	Legal aid to tortured women, handicrafts centre.
87. Nirmal Hridoy	54A, Lower Circular Road, Kolkata – 16, Ph :22447115.	Shelter for ill, poor and vagabond women.
88. Paresh Samity Mahila Silpa Sikshalaya	3, Panditia Terrace, Kolkata – 29.	Handicrafts training centre.
89. Paripurnata	5B, Maharani Swarnamoyee Road, Kolkata – 9, Ph : 23504073.	Legal counselling for tortured women, lunatic asylum.
90. Paschimbanga Ganatantrik Mahila Samity	31 Alimuddin Street, Kolkata-16, Ph.- 22444589/3131	Legal aid and counselling to tortured women.
91. Pankaj Acharya Nivas	P-230, C.I.T. Scheme, Kolkata-54, Ph: 23586141	Shelter for working women.
92. Nari-O-Sishu Kalyan Sanstha	Kasba Industrial Centre, Kolkata – 42	Handicrafts training centre, tailoring training.

93. Paschimbanga Mahila Samabai Mahasangha Limited	12, B.B.D.Bag, Kolkata – 1 Ph.- 22102951/4363	Sales counter for processed foods.
94. Pragati	23, R.N.Mukherjee Road, Kolkata-1, Ph.-22482951	Handicrafts training centre.
95. Refugee	125, A.B.B.Ganguly Street, Kolkata-12 Ph.- 22419530,22484552	Shelter for orphan children, training in tailoring.
96. Refugee Handicrafts	2A & 3A Gariahat Road, Kolkata-19, Ph.-24753346/47	Sales counter of handicrafts.
97. Sister Nivedita School	6, Nivedita Lane, Kolkata-3	Training centre for handicrafts.
98. Saroj Nalini Dutta Memorial Assciation		Legal counselling for tortured women, shelter for working women.
99. Sarbasanti Oug	1C, Chotubabu Lane, Kolkata-14, Ph.-22449761	Handicrafts training centre as well as sales counter.
100.Seva Kendra Kolkata	52B, Radhanath Chowdury Lane, Kolkata-15, Ph.-22440381	Legal aid to tortured women.
101.Sir Syed Group of School	71/1C, D.H.Road, Khidirpur, Kolkata -23	Counselling centre for tortured and drug addicted women.

102. Society for children Welfare	22, Colonel Biswas Road, Kolkata-29, Ph.- 22473121	Centre for adoption of children, shelter for orphans.
103. Socio Legal Day Research and Training centre	P-12, Lake Terrace, Kolkata-29, Ph.-24686098	Counselling centre for tortured and drug addicted women.
104. Santi Niwas Oxford Mission	Barisa, Kolkata –4	Shelter for fit women above 70 yrs.
105. Sramojibi Mahila Samity	324, Basunagar, Madhyamgram, 24 Pgs, 743275. Ph.-25384779	Rehabilitation centre for poor and tortured women.
106. Sramik Vidyapith	56, A.B.T.Road, Kolkata-50 Ph.- 25574643	Women's training centre for tailoring, embroydery, book binding, oven and TV repairing.
107. Forum	3/F, Pal Avenue, Kolkata – 19	Legal aid to tortured women.
108. Sonali	F-1, Dakshinapan, 2 Gariahat Road, Kolkata – 68, Ph.-24731980	Marketing for handicrafts produced by NGOs.
109. Paper Pulp Craft Centre	Banghar, 4C, Kulti Colony, Gobindanagar; Ramrajatala, Howrah	Training in paper board & embroydery.

110. Vivek Chetana	2/3-A, Keyatala Road, Kolkata-29, Ph.-24644114	Training in tailoring, embroydery.
111. Voice of People	Spandan, Garia, Dt.-24 Pgs(S)	Training in tailoring, embroydery, sewing, paper-making.
112. West Bengal Council of Women	Bemuri, Kuchurpur, Dist.- Hooghly	Training in tailoring, embroydery, sewing and food-processing.

Source : Chetana,2001

There are some NGOs in Kolkata who have been taking care of street-childreen and child-labours for a long time. The names of these NGOs are :

● Ashalayas ● All Bengal Women's Union Children's Welfare Home ● Basti Local Committee and Social Welfare Centre ● Bengal Mass Education ● Bastibasi Samonnay Samity ● Kolkata Social Project ● Chinnomul Sromojibi Adhikar Samity ● CINI ● Council for Social Development ● Child Care Home ● Centre for Social Development ● Development Dialogue ● Forum of Committees in Service ● Gana Unnayan Parishad ● Humanity Association ● Indian Council of Social Welfare ● Institute for Development Education and Educational Research ● Janasiksha Prachar Kendra ● Loreto Day School (Sealdah) ● Life Welfare Society ● Mass Welfare Society ● Mary Little Clinic ● Paribarik ● Purbachal Udayan Sangha ● Prantik Jana Vikash Samity ● Raosani Social Welfare Centre ● Centre for Homeless National Forum (India) ● Sister Adores ● Spastic Society Eastern India Society for Educational and Environment Development ● Swadhin Bharat Yuva Sangha ● Tiljola Basti Development Association ● Social Action Society ● Society for Indian Children's Welfare ● United Friends' Circle ● The Refugee ● Socio-Legal Aid Research and Training ● United Basti Development Association ● Vivekananda International Health Centre ● Vivekananda Education Society ● West Bengal Council for Children's Centre ● Women's Coordinating Council.

In August of 1945 America dropped nuclear bombs at Hiroshima and Nagasaki of Japan. Since this loathesome massacre the people of West Bengal have raised their voices against nuclear war vehemently. During 1980s an organisd movement for anti-nuclear war initiated in our state. Some NGOs have come forward in this movement. They are: **Bangiyo Bijnan Parishad, Utso Manush, Kanchrapara**

Bijnan Darbar, **Kharagpur Science Education Group**, **Anti-Nuclear Forum** and **Paromanu Astra Birodhi Prachar Avijan, Paschim Banga**. The passionate involvement of these NGOs has made the anti-nuclear movement more powerful.

In the movement of anti-militarism and anti-nuclear war the role of **Sabujer Avijan**, an NGO of Barabazar, Chandannagore, Hooghly, is very applaudable and exemplary. Sabujer Avijan is ardently vocal for war-free world. This NGO organises environment fair, environmental awakening workshops and publishes regularly booklets, pamplets and books on environment.

The field of activities of NGOs in West Bengal is much more extensive than the day to day performances of political parties. NGOs go on working with their ideologies from protesting against evacuation of slums to foundation of nuclear centres. They often organise various reformative movements under political banner. Recently the Government of West Bengal has extended its helping hand to the NGOs to promote mass education and in healthcare service. Very interestingly it has been noticed that NGOs are more active in South Bengal. Their activities are more intense in the districts of 24 Pgs.(N), 24 Pgs.(S), Kolkata, Medinipur (E), Burdwan and Hooghly.

Conclusion

The future of NGO sector depends upon two crucial issues. One is non-governmental set up, the other is 'Panchayatraj'. Panchayatraj means power to people. The character of NGOs here has been transformed from implementation agency to a kind of legal agency. Secondly, the grass-root organizations are to take a major accountability in shaping NGOs to an organized sector. Local NGOs act as grass-root organizations.

Hence, a sense of awareness need be developed in them for this purpose because most of the local NGOs do not have any goal or policy or strong vision to achieve by collective power, especially in India. In our country most of the local NGOs import ideas or policies from overseas. They desperately need a reform in them.

There are some people in NGO sector who have come here only for their aggrandizement. This has already been proved from their movements. They may be professionally sound, may mobilize funds, but they use their deftness for self-interest. In this field they have no social commitments for people. As an organized sector NGOs should identify this type of people. The most essential feature of an NGO is establishment of credibility. Only when the NGOs are able to establish credibility, they can transform themselves to an organised sector. Here, high level of advocacy is deeply needed.

One point to note that no alternative can be achieved overnight. The forms of alternative differ in regions and over issues. Hence, it is important to choose the appropriate alternative in economic, political, technological and cultural context. For this, grass-root activities need be continued to exist in this world of globalization. In grass-root activities different corporate sectors as well as government organizations are welcomed because they also have some social responsibilities and duties to perform. Even those who have the capability and responsibility to bring a change in society are also welcomed in the path of alternative movement. And to achieve this goal, if necessary, adjustments and modifications should never be set aside.

Acknowledgement

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References

1. **Chetana** : *Dui Banglar NGO*, Ed. By Chandan Ghosh and Rakhalraj Chattopadhyay, 2001.
2. **Green Governance** : *WBPCB*, Vol – V, Issue – II, August, 2004 ; Vol – V, Issue – III, December, 2004.
3. **James, P, J** : *Non-Governmental Voluntary Organisations – The True Mission*, Mass Line Publications, 1995.
4. **Ray. R** : *Paribesh Andolan O Paschim Banga*, in 'Paschimbanga: Phire Dekha' – ed. By R. Ray, Prateeti, 2003.
5. **West Bengal Environmental Campaign : An Update** : *WBPCB*, Deptt. Of Environment, Govt. of West Bengal, 2003 – 2004.

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